



Wind Statistics Offshore based on Satellite Images

Hasager, Charlotte Bay; Mouche, Alexis; Badger, Merete; Nielsen, Morten; Astrup, Poul; Karagali, Ioanna

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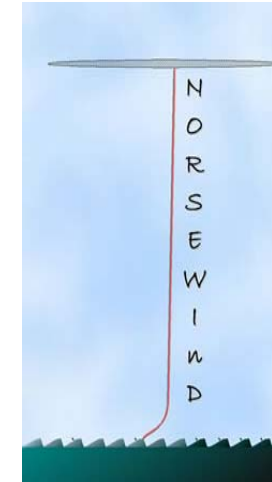
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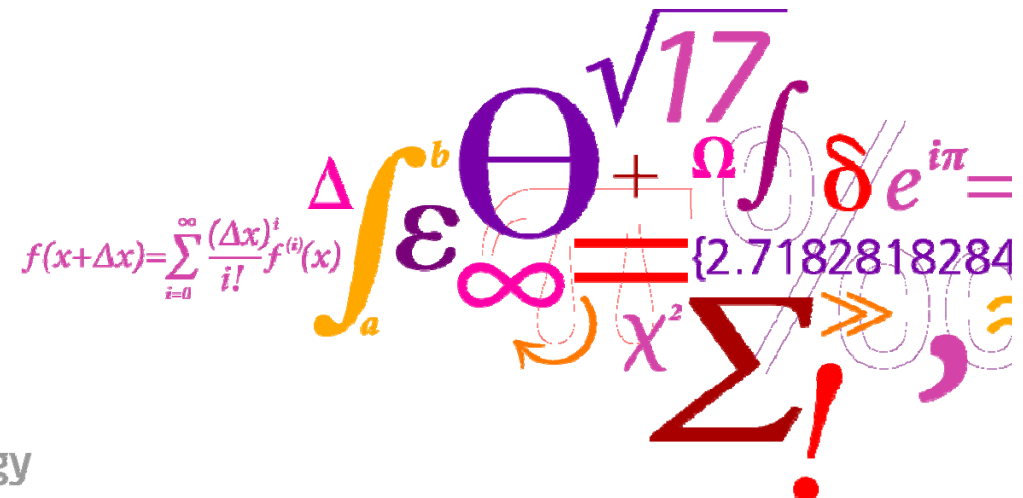
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Wind statistics offshore based on satellite images

Charlotte Bay Hasager, Merete Badger, Poul Astrup, Morten Nielsen,
Ioanna Karagali, Risø DTU

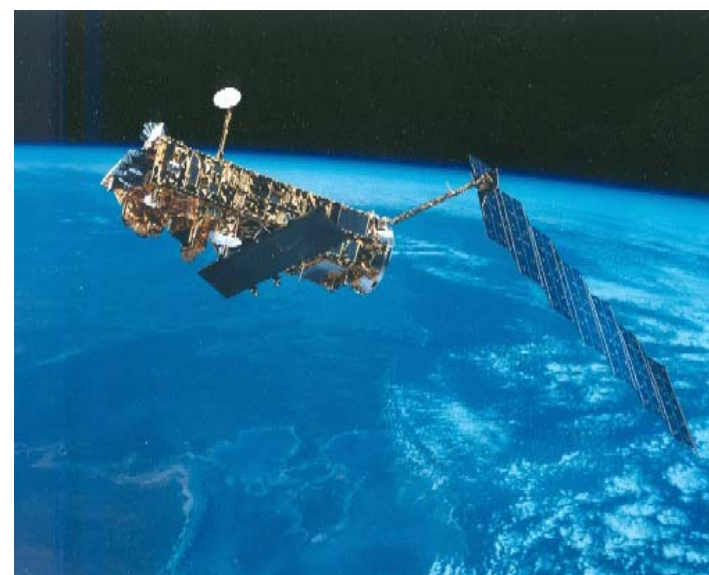
Alexis Mouche, CLS, France



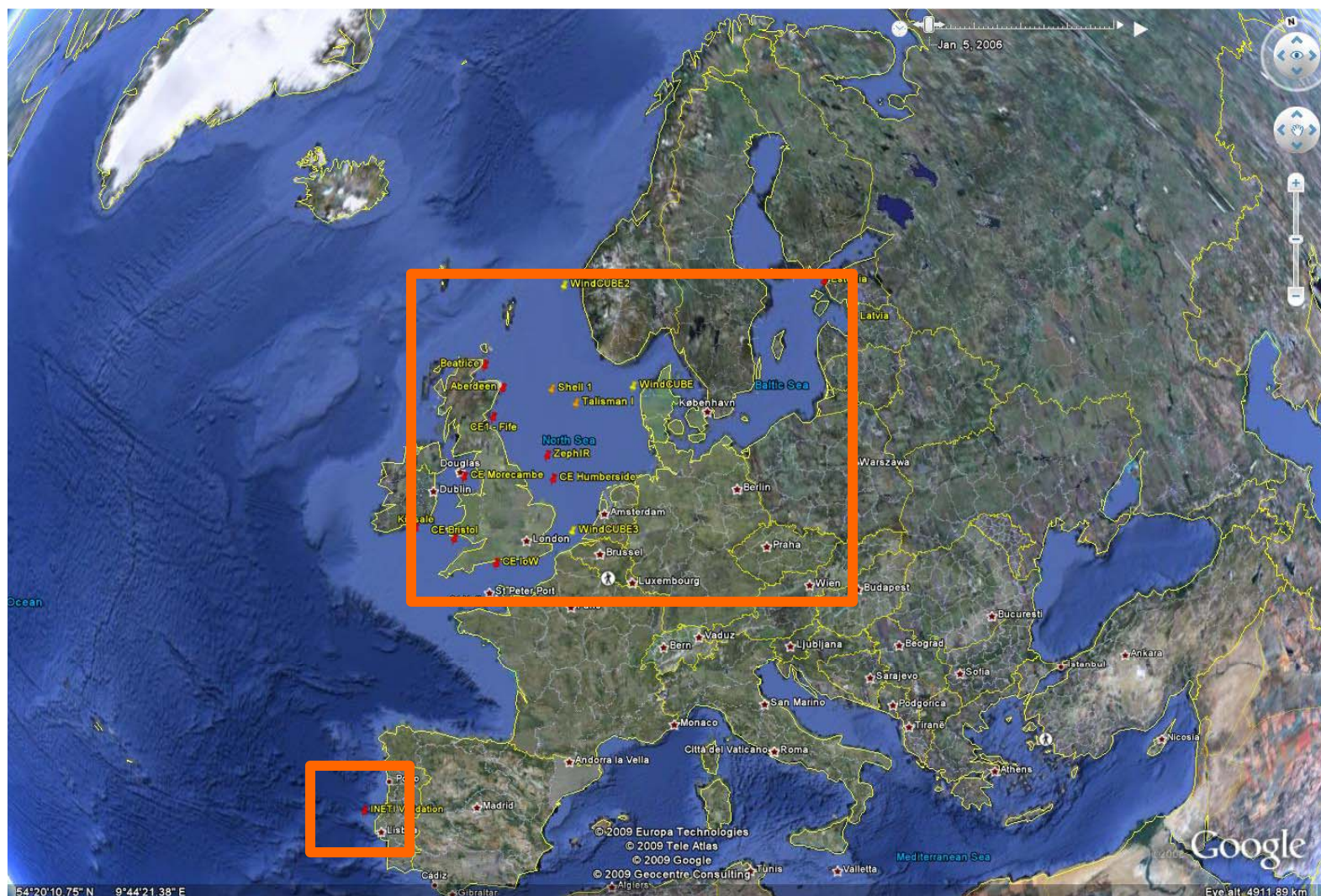
Risø DTU
National Laboratory for Sustainable Energy

Content

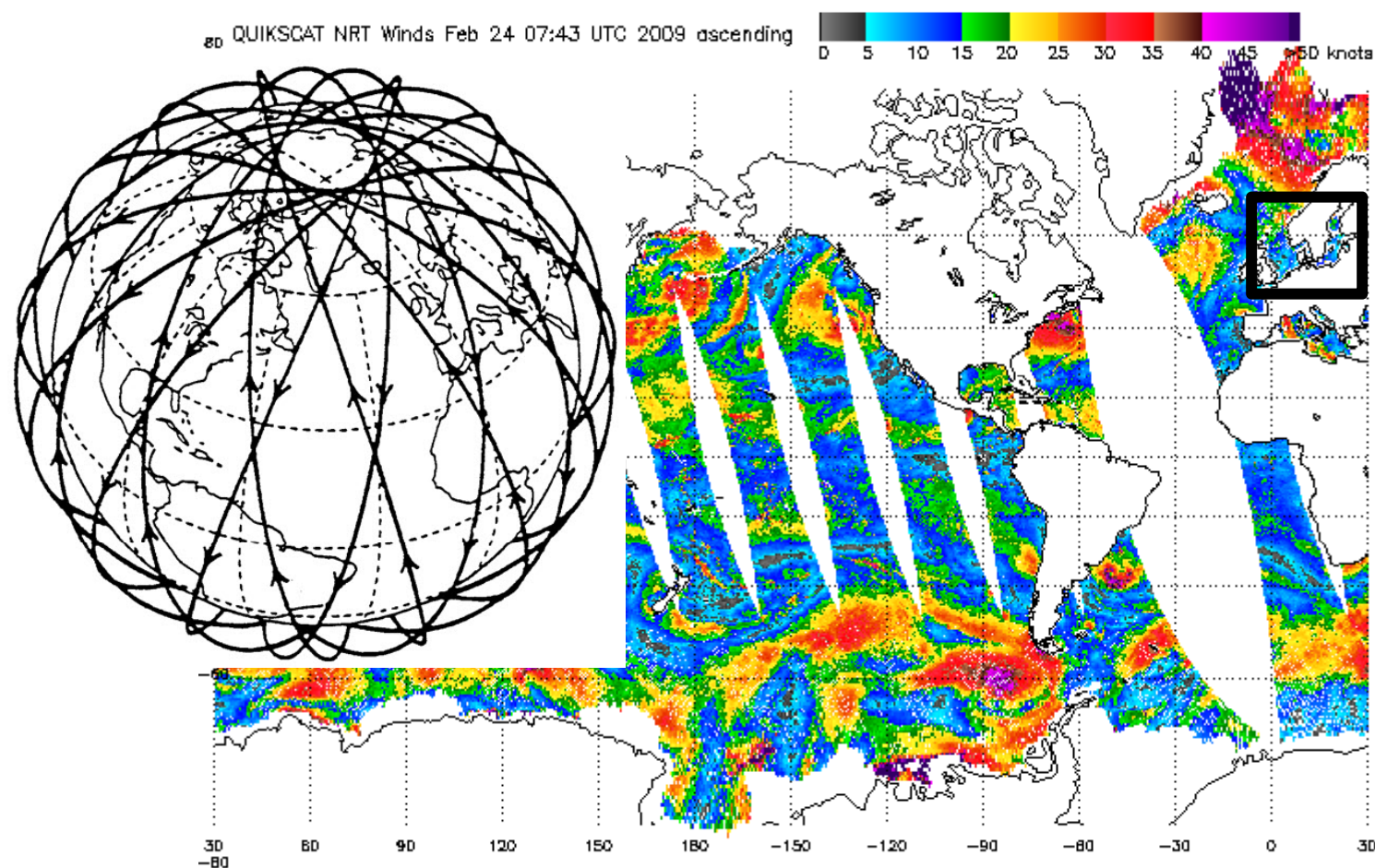
- Offshore sites
- QuikSCAT analysis
- Envisat SAR analysis
- Future



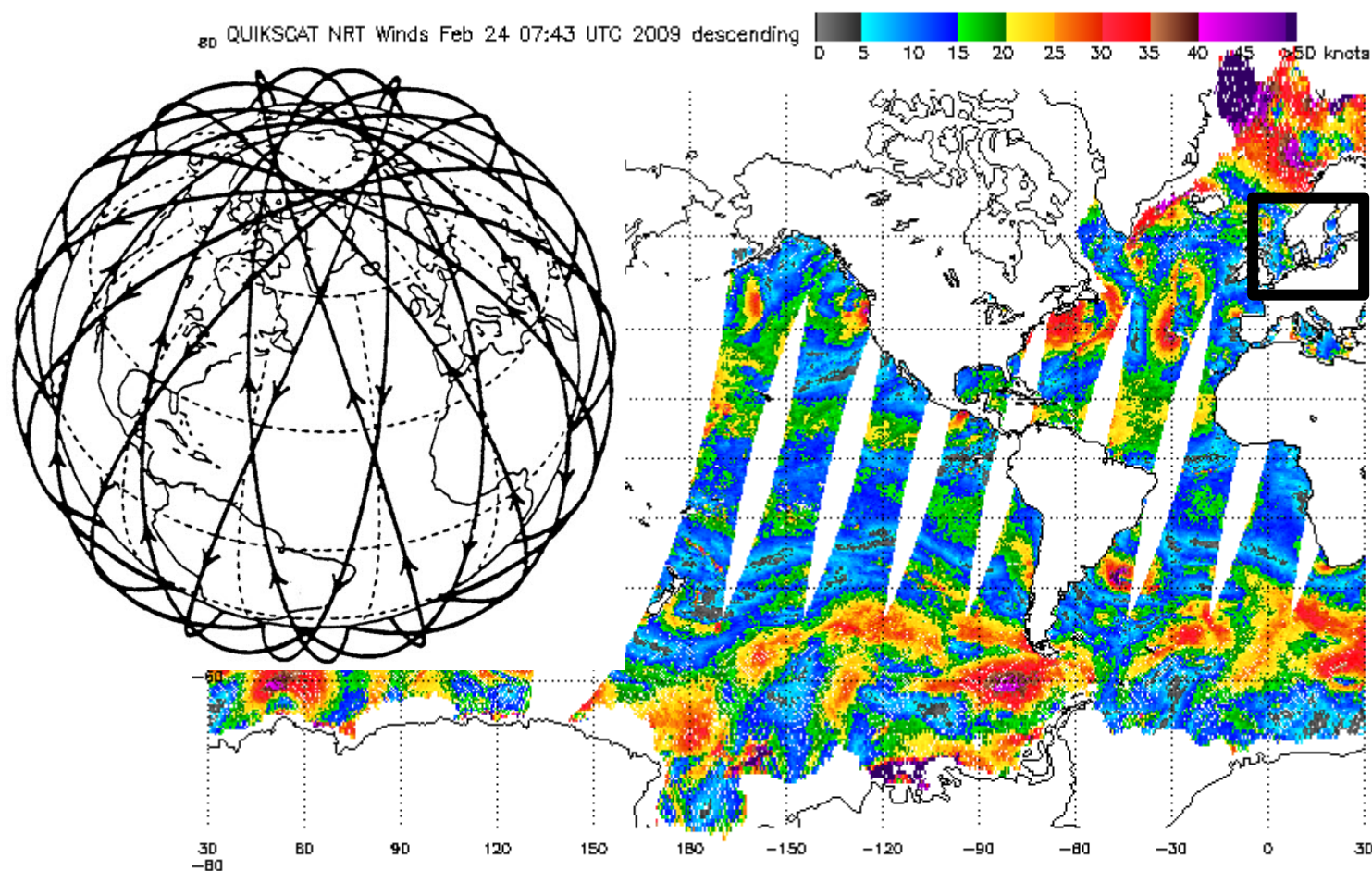
Norsewind: project domain for offshore wind



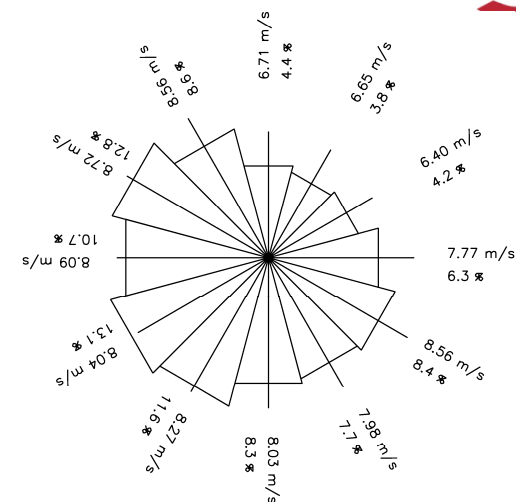
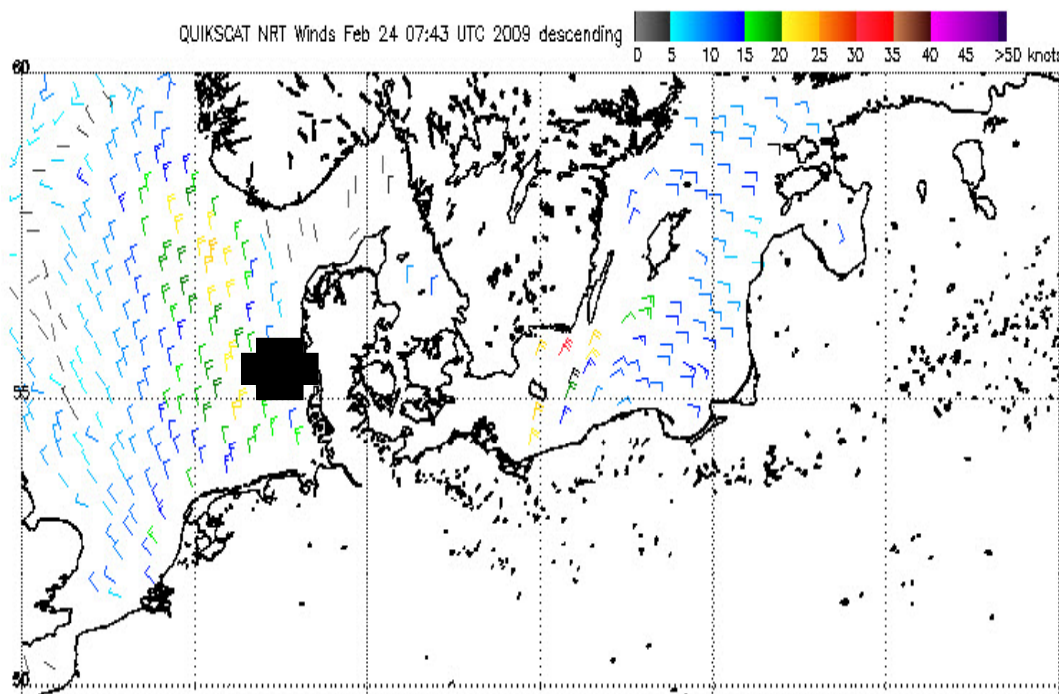
Wind map: QuikSCAT - morning



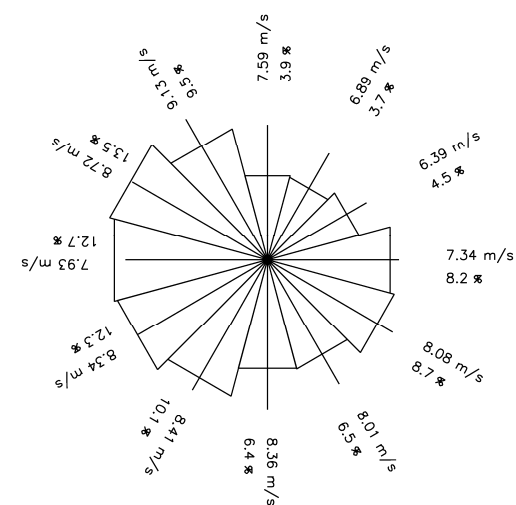
Wind map: QuikSCAT – afternoon



Comparison at Horns Rev



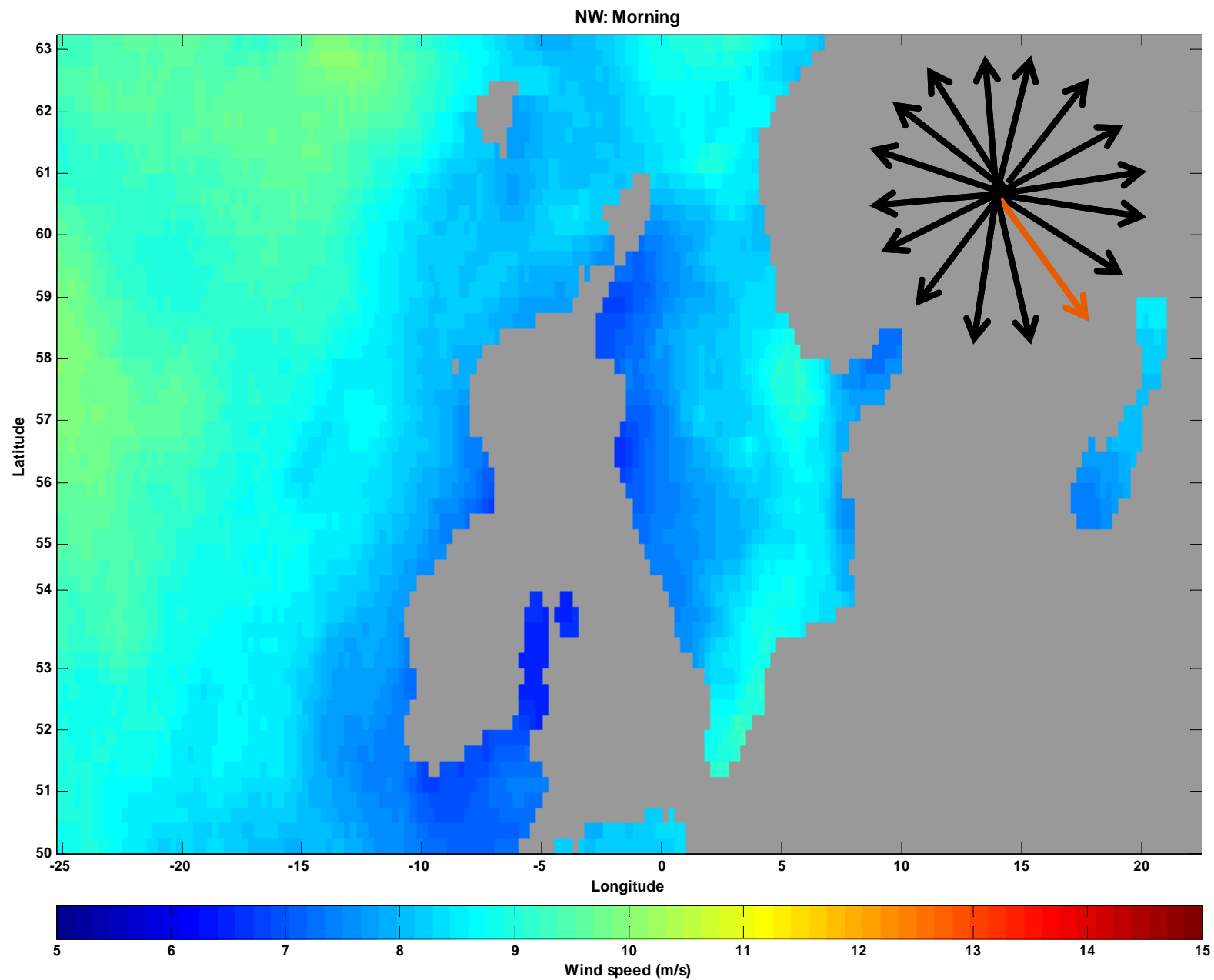
Mast (courtesy DONG energy)



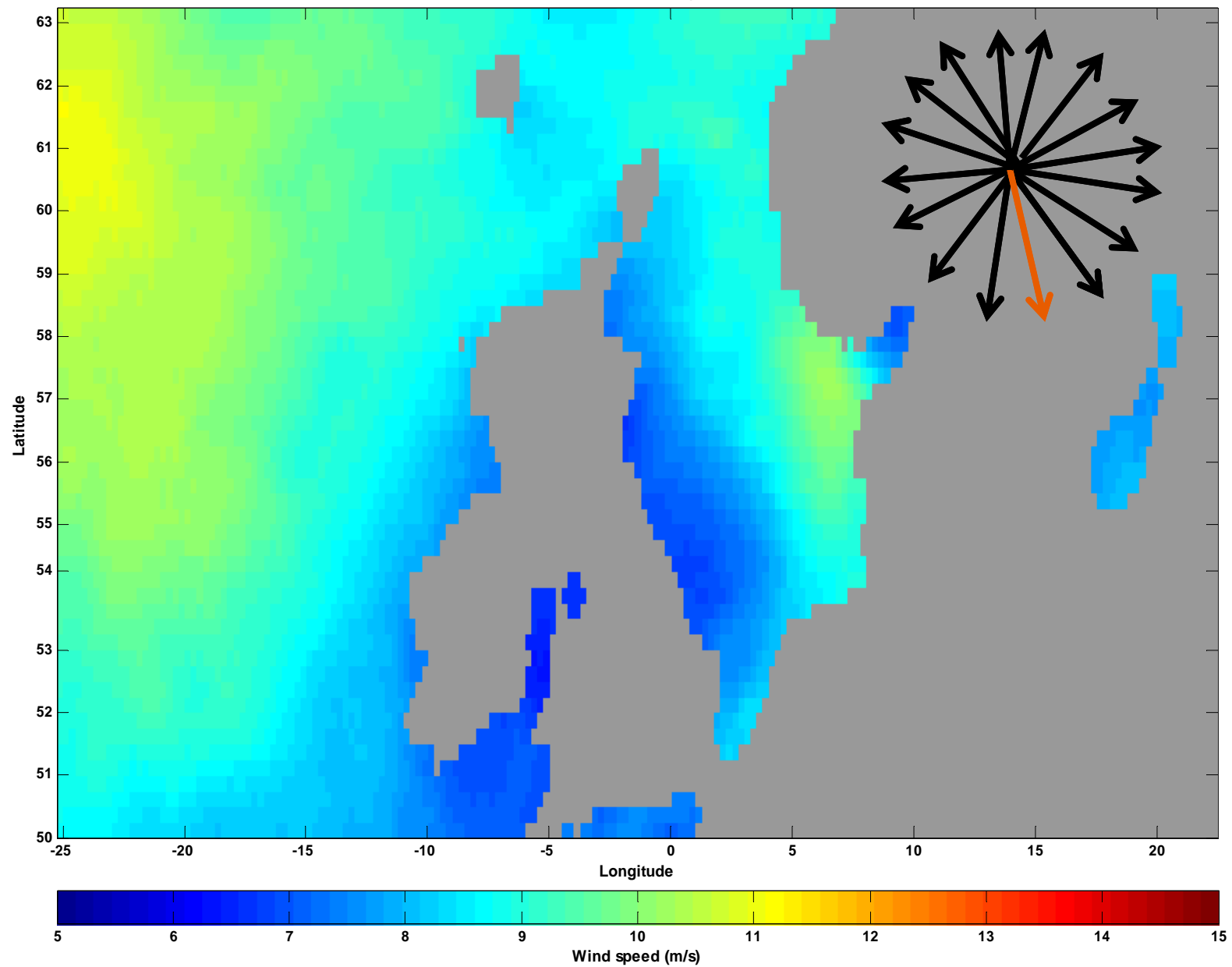
QuikSCAT

Hasager, C.B., A.Peña, M.B.Christiansen, P.Astrup, M.Nielsen, F.Monaldo, D.R.Thompson, and P.Nielsen. "Remote sensing observations used in wind energy." IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 1, no. 1(2008): 76-79

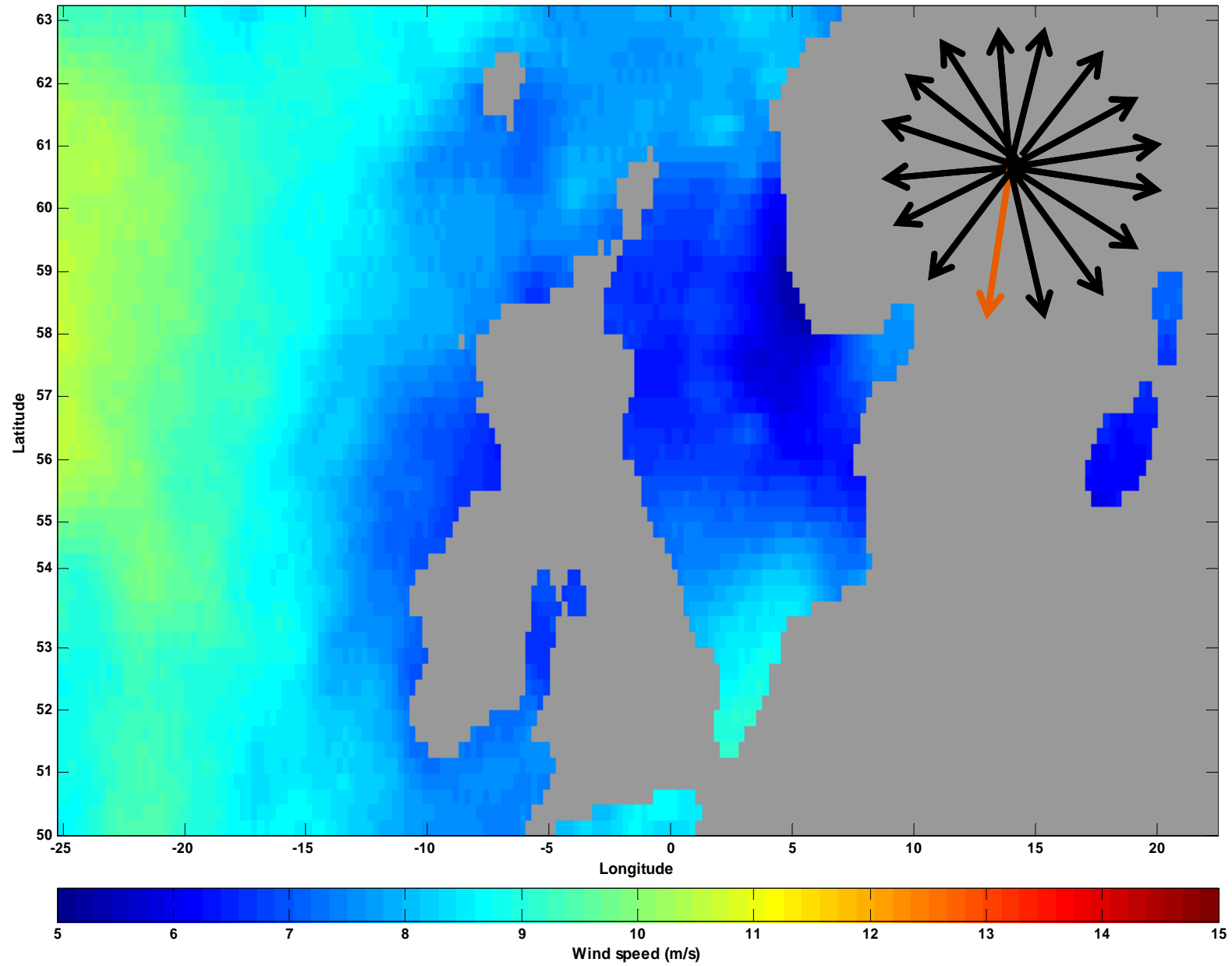
Average Wind Speed: Morning (based on wind direction at Horns Rev) - 16 Directions



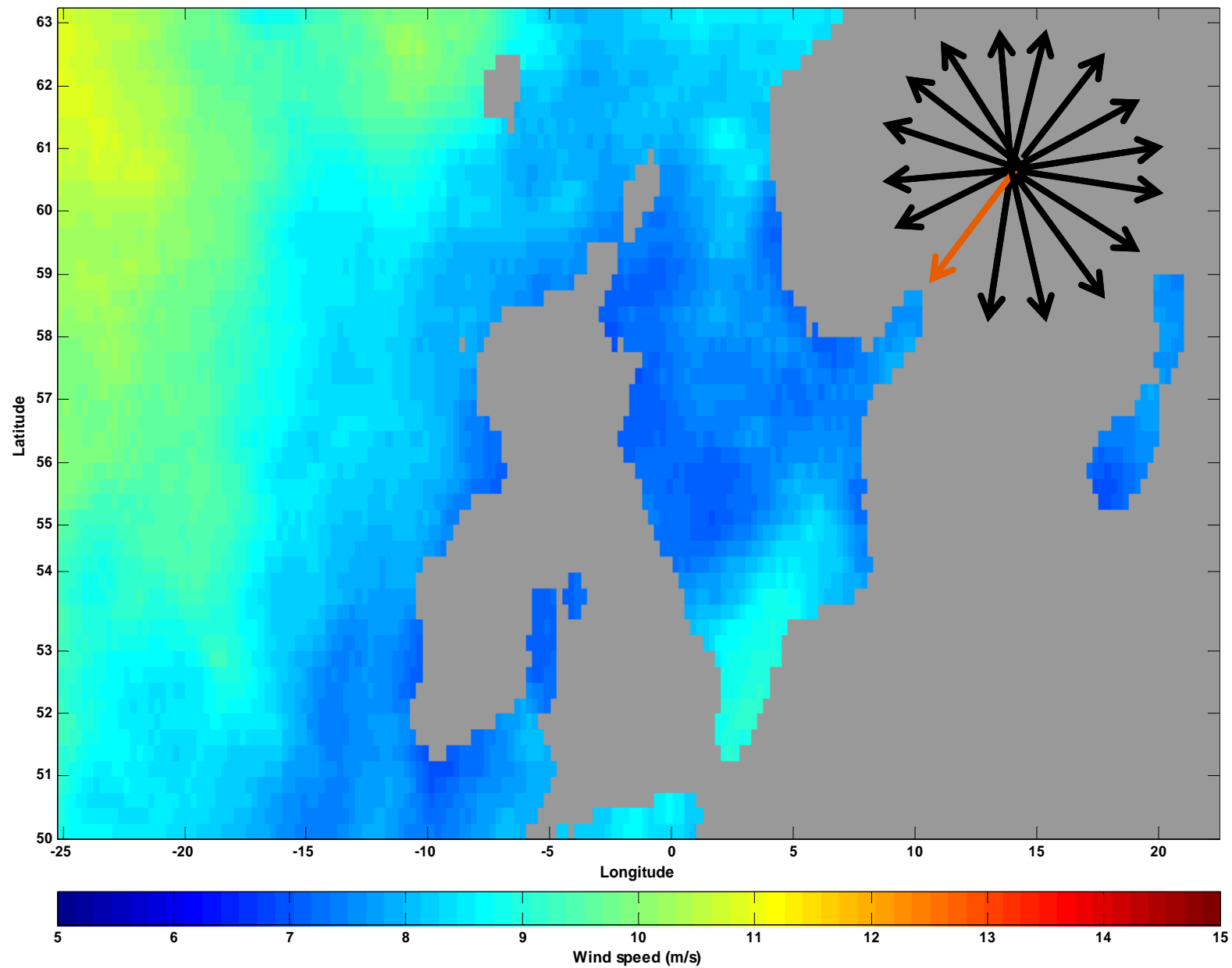
NNW: Morning



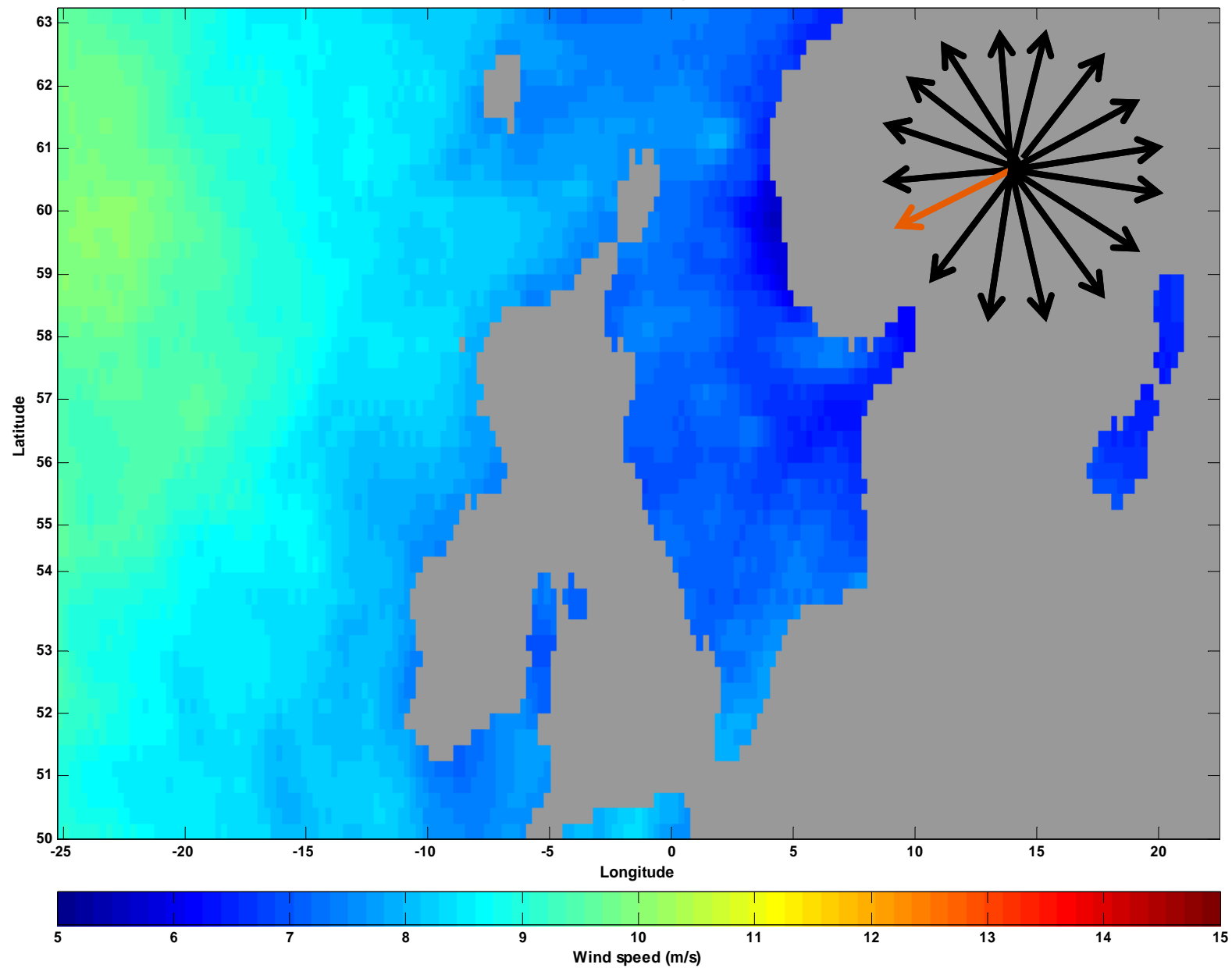
NNE: Morning



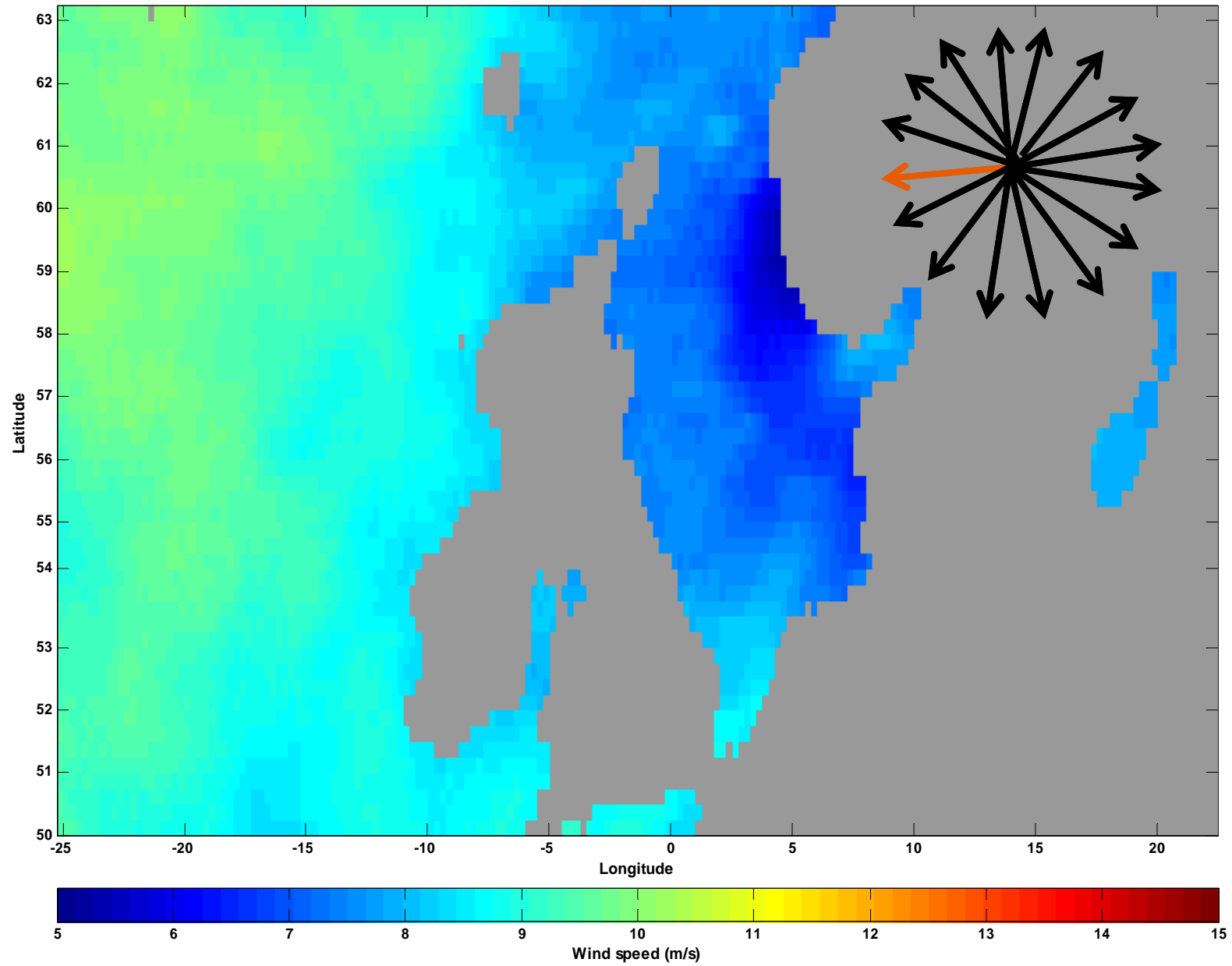
NE: Morning



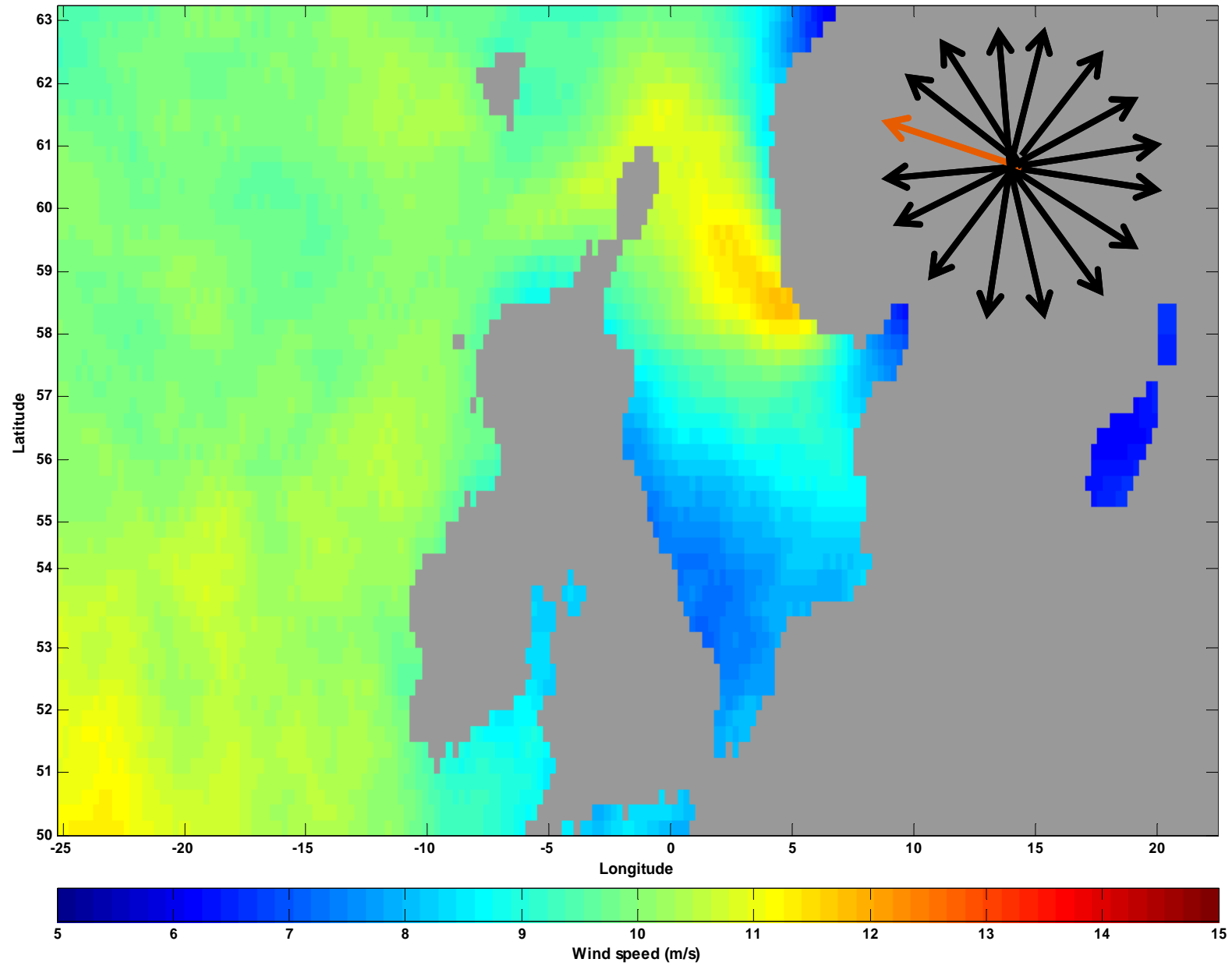
EN: Morning



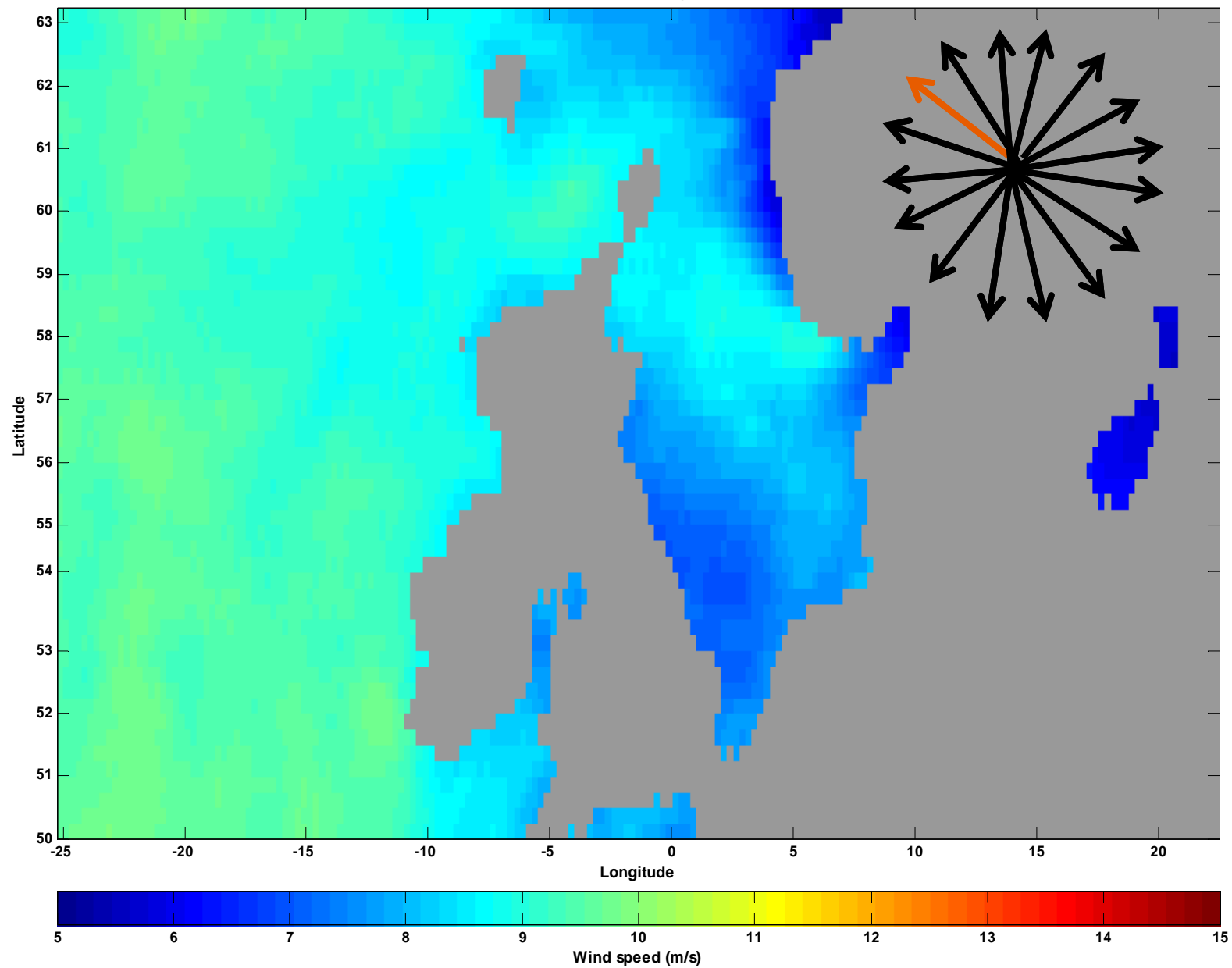
ENE: Morning



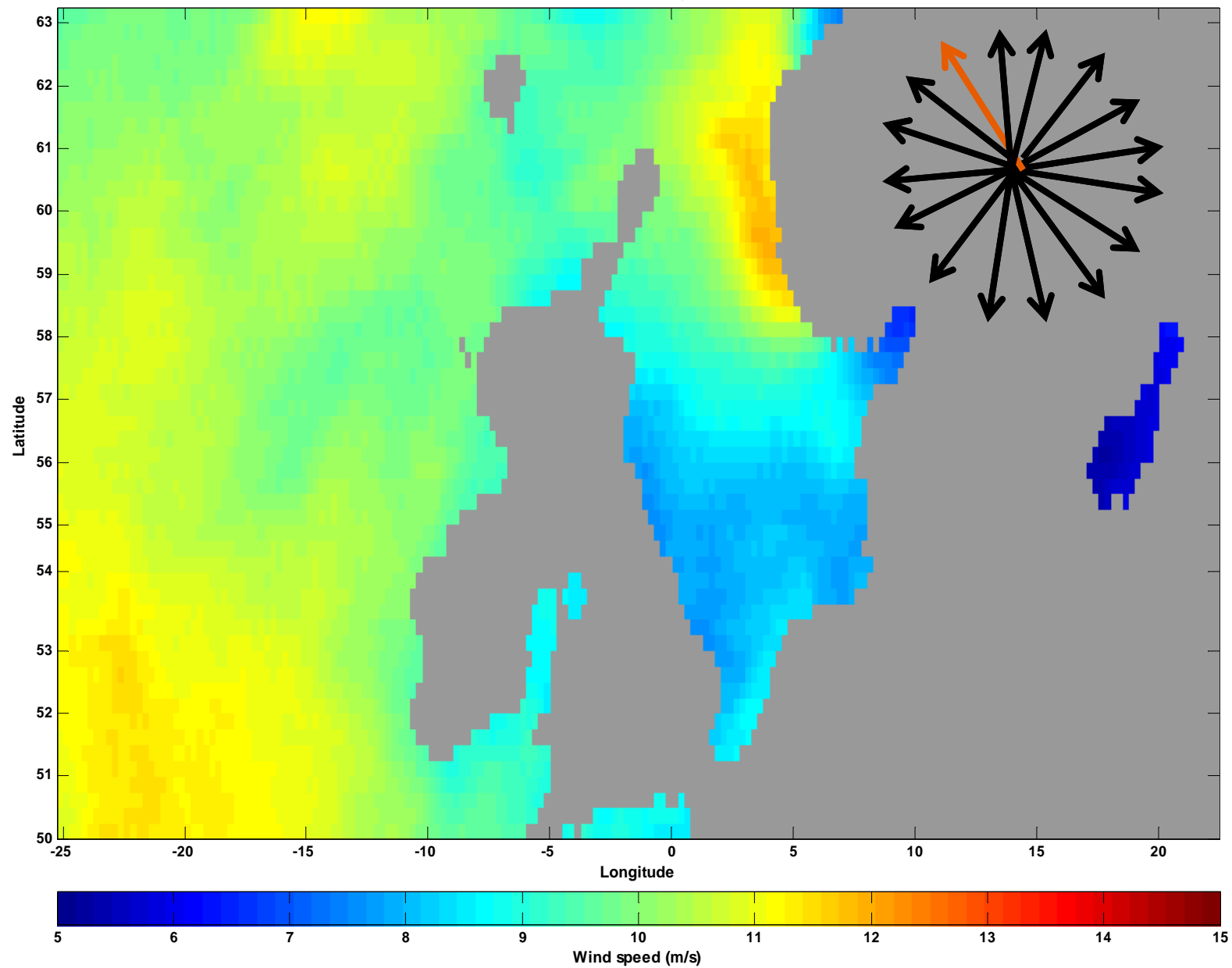
ESE: Morning



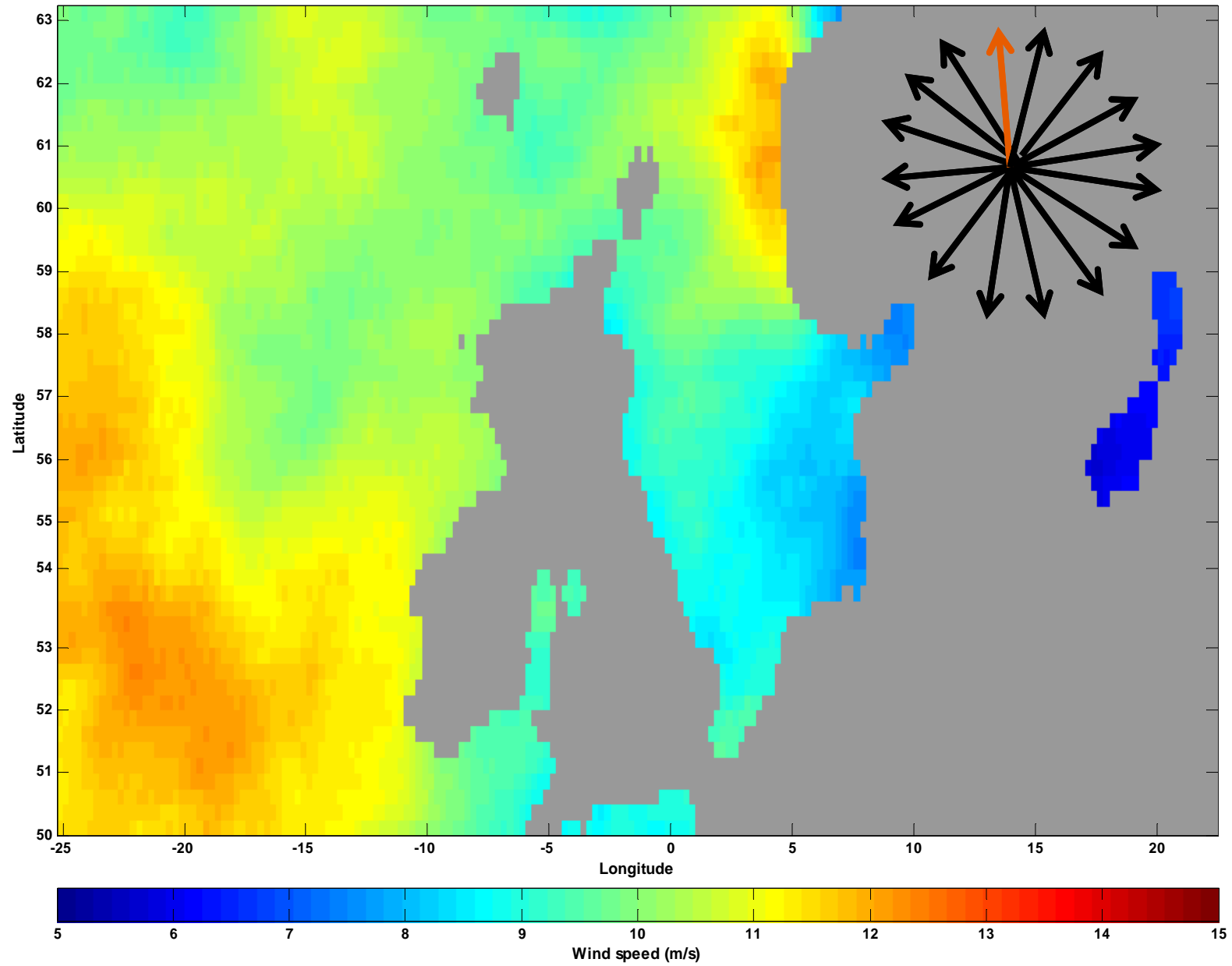
ES: Morning



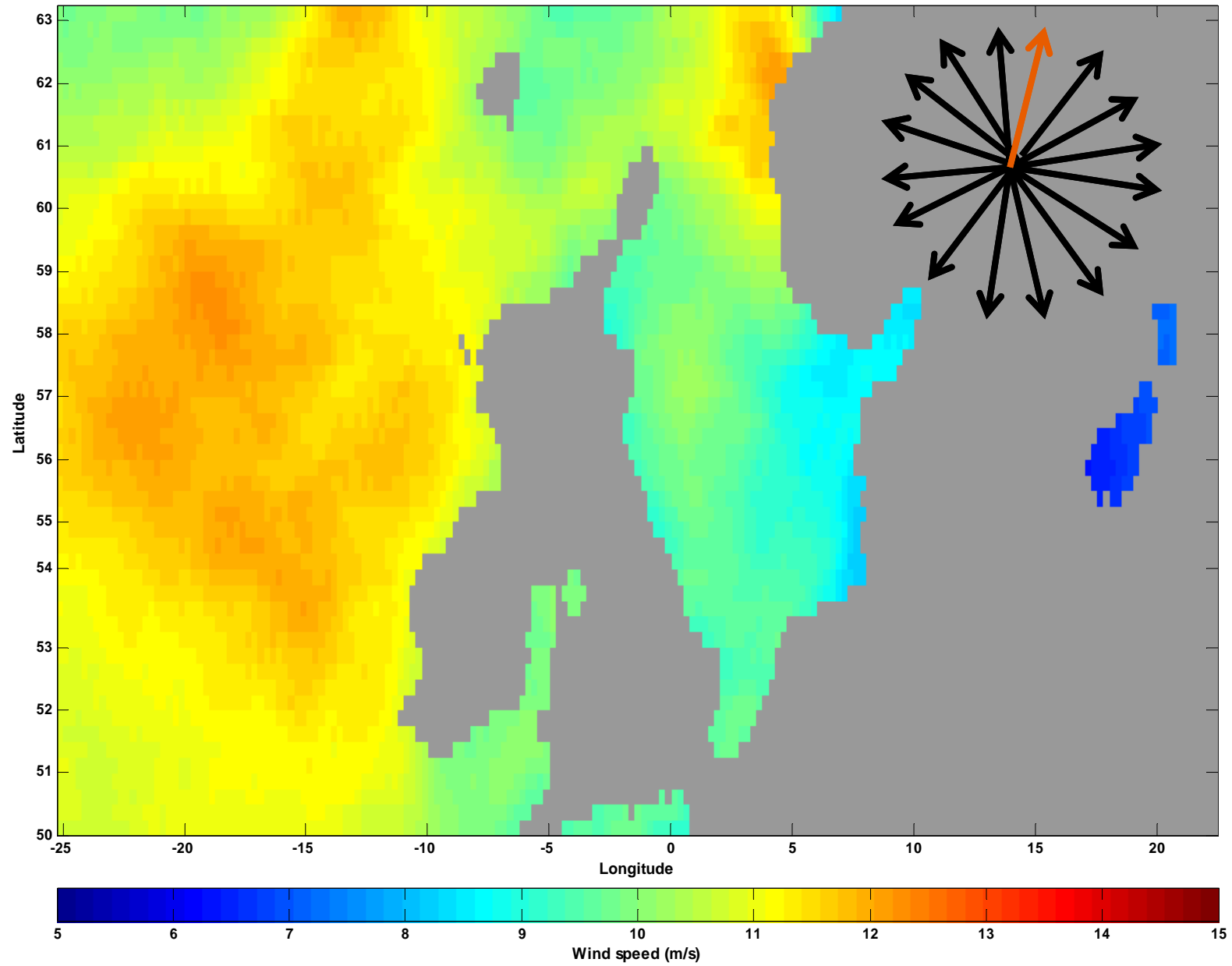
SE: Morning



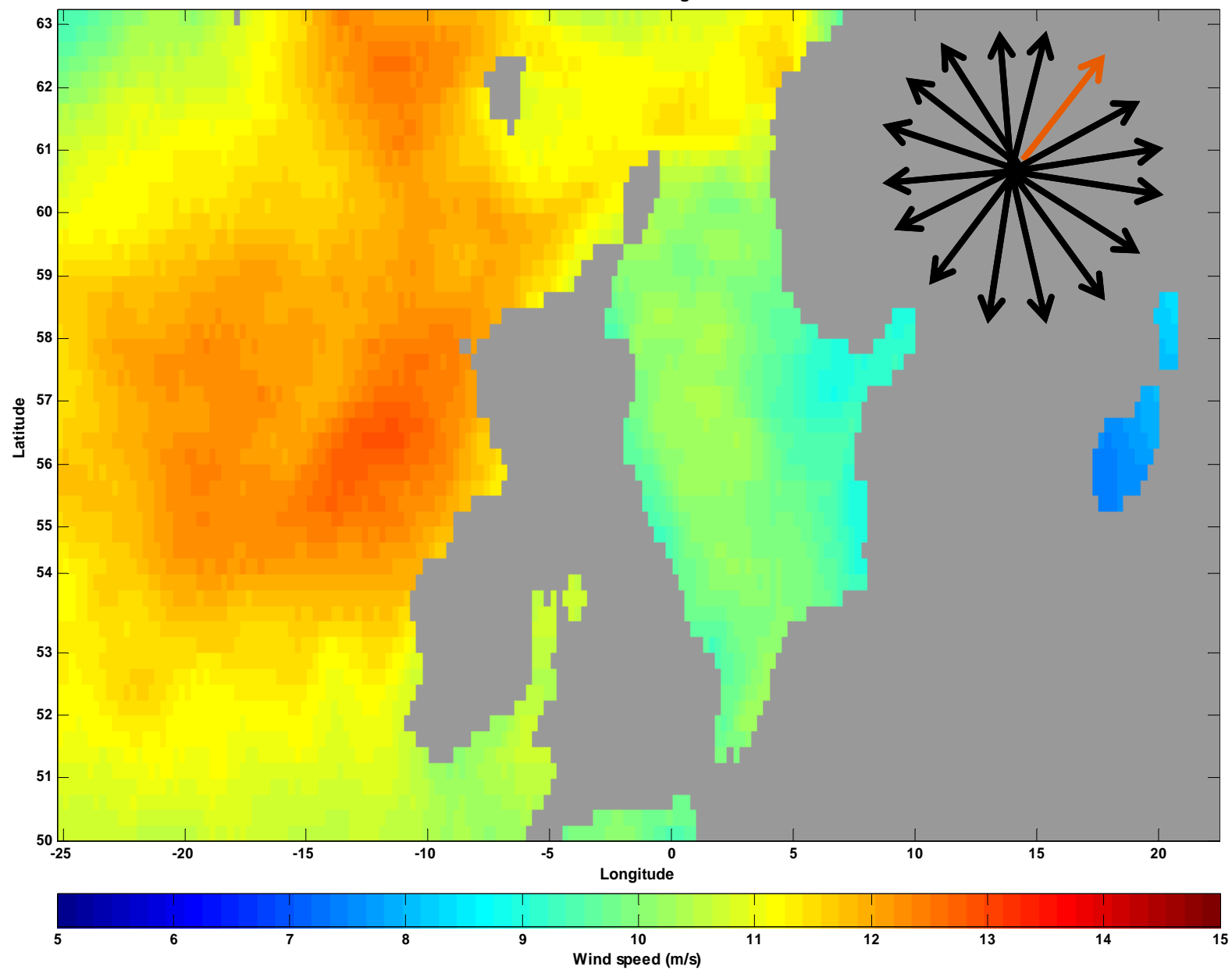
SSE: Morning



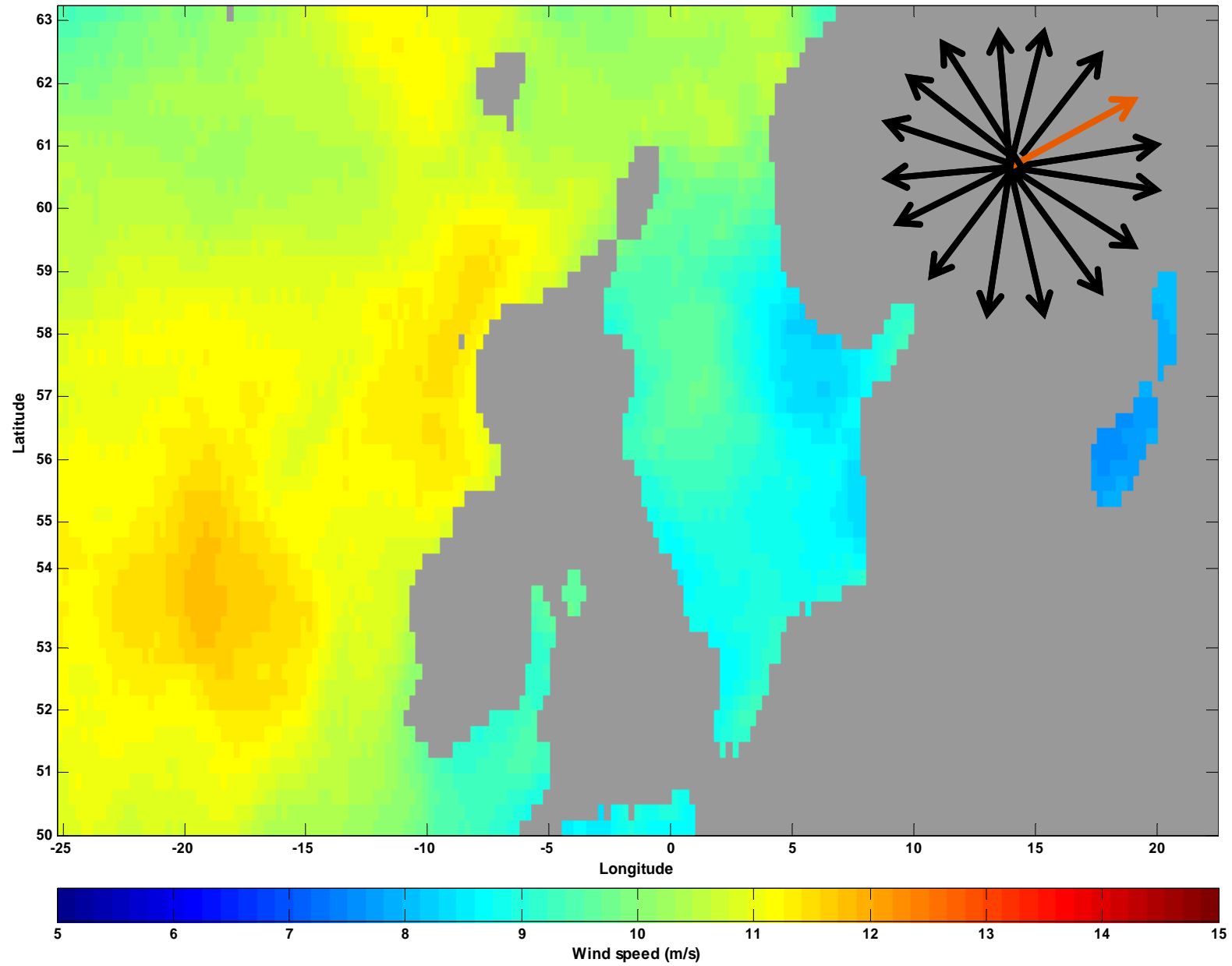
SSW: Morning



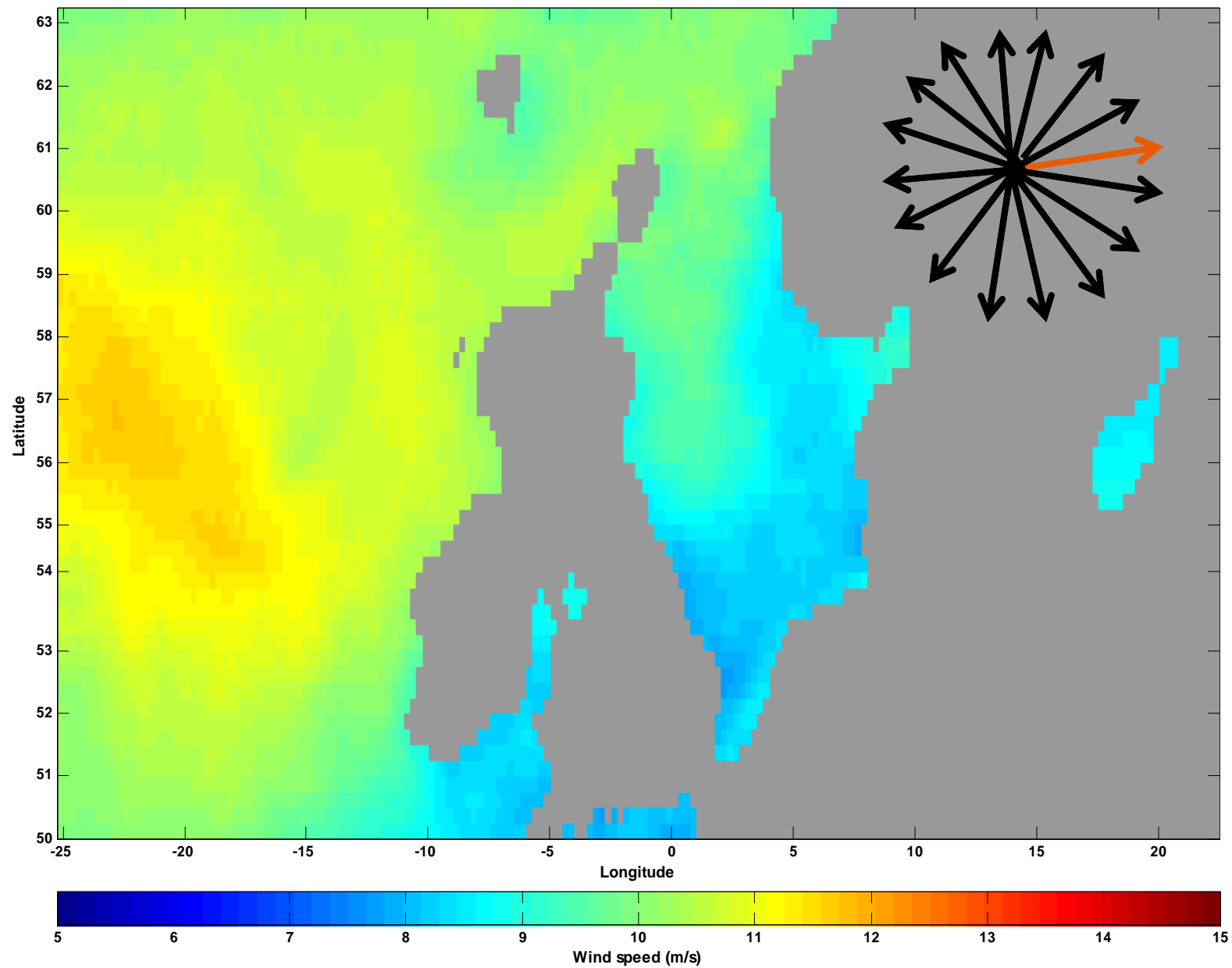
SW: Morning



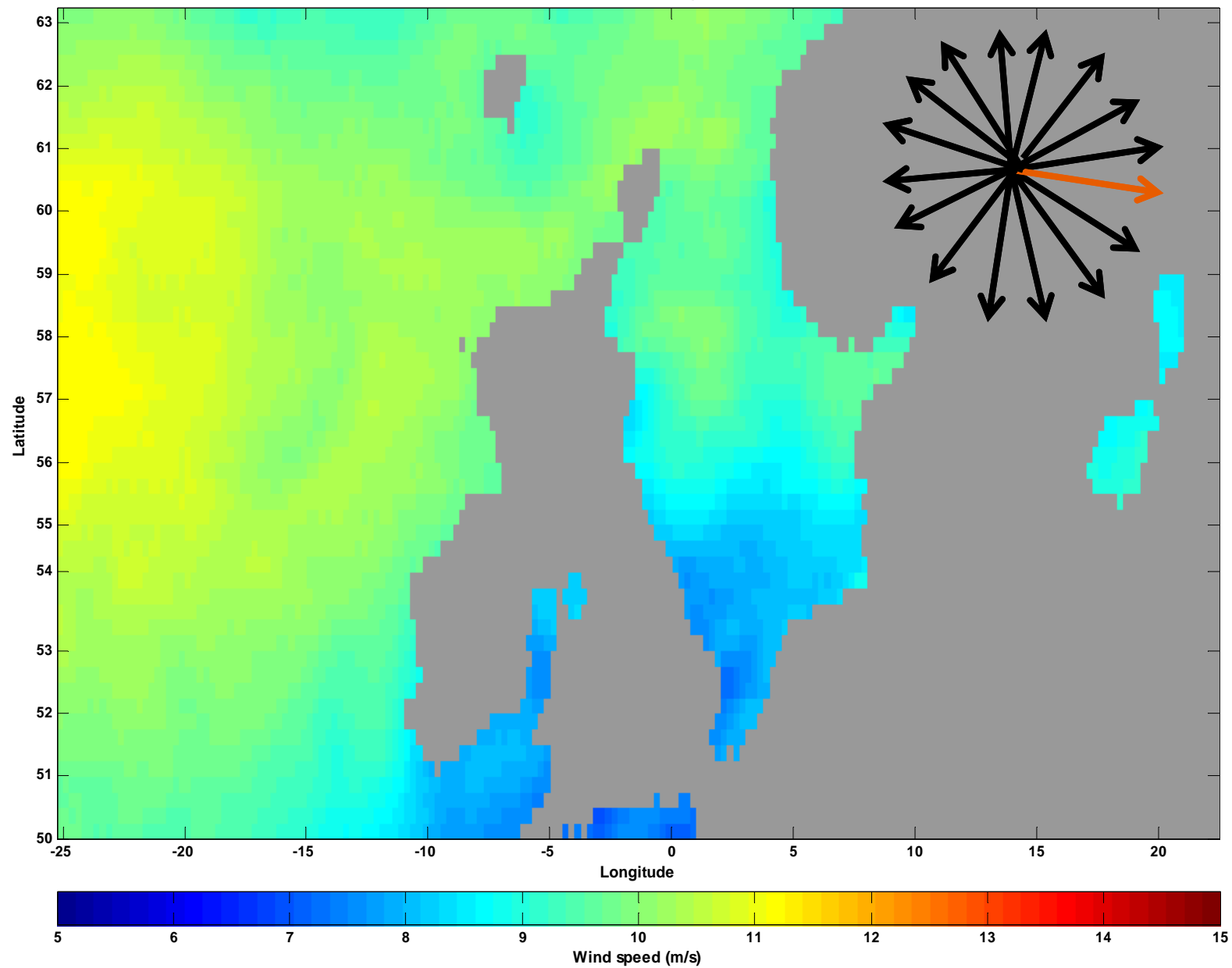
WS: Morning



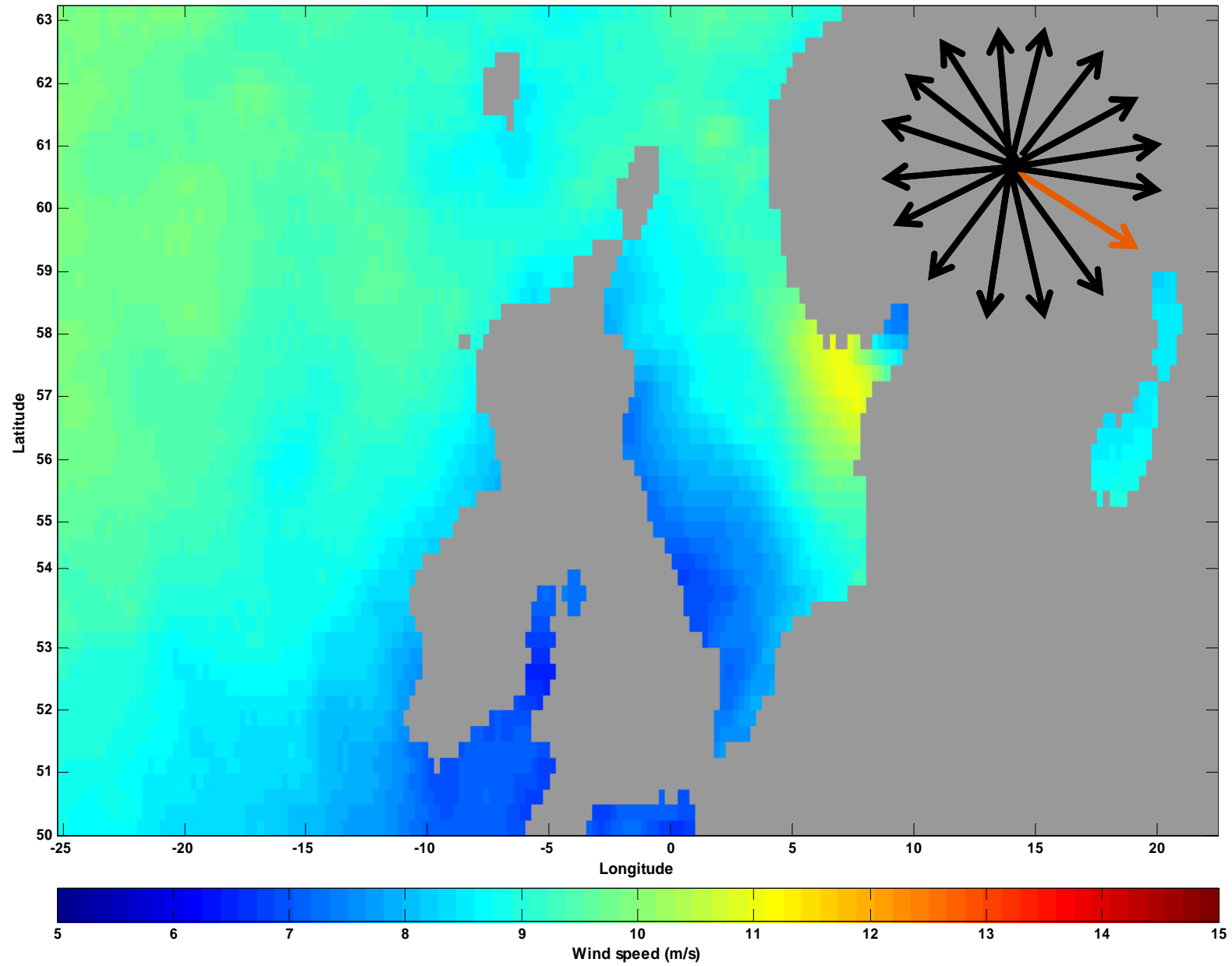
WSW: Morning



WNW: Morning



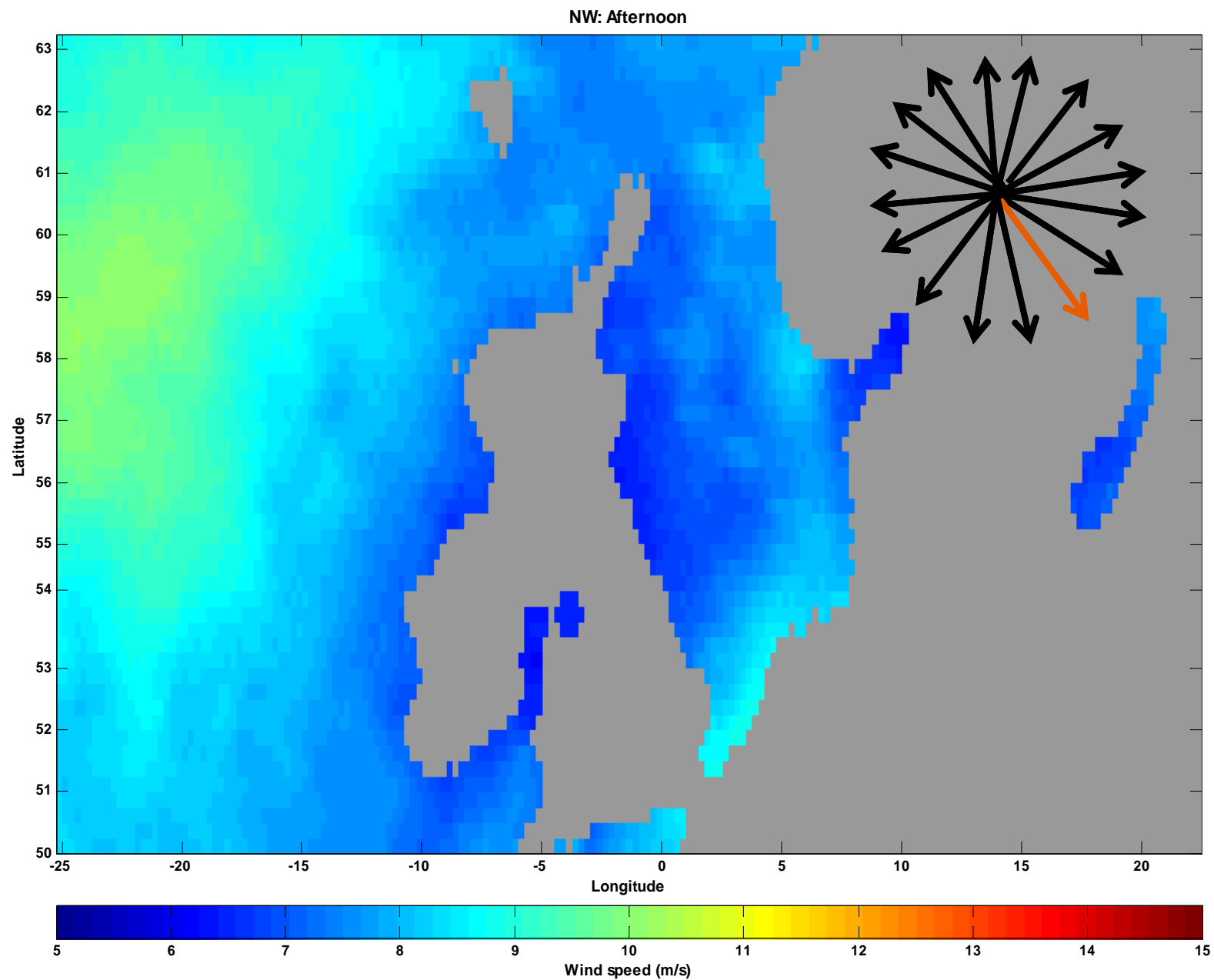
WN: Morning



Wind maps

- ~ 3500 morning
- ~ 3500 afternoon

Average Wind Speed: Afternoon (based on wind direction at Horns Rev) - 16 Directions

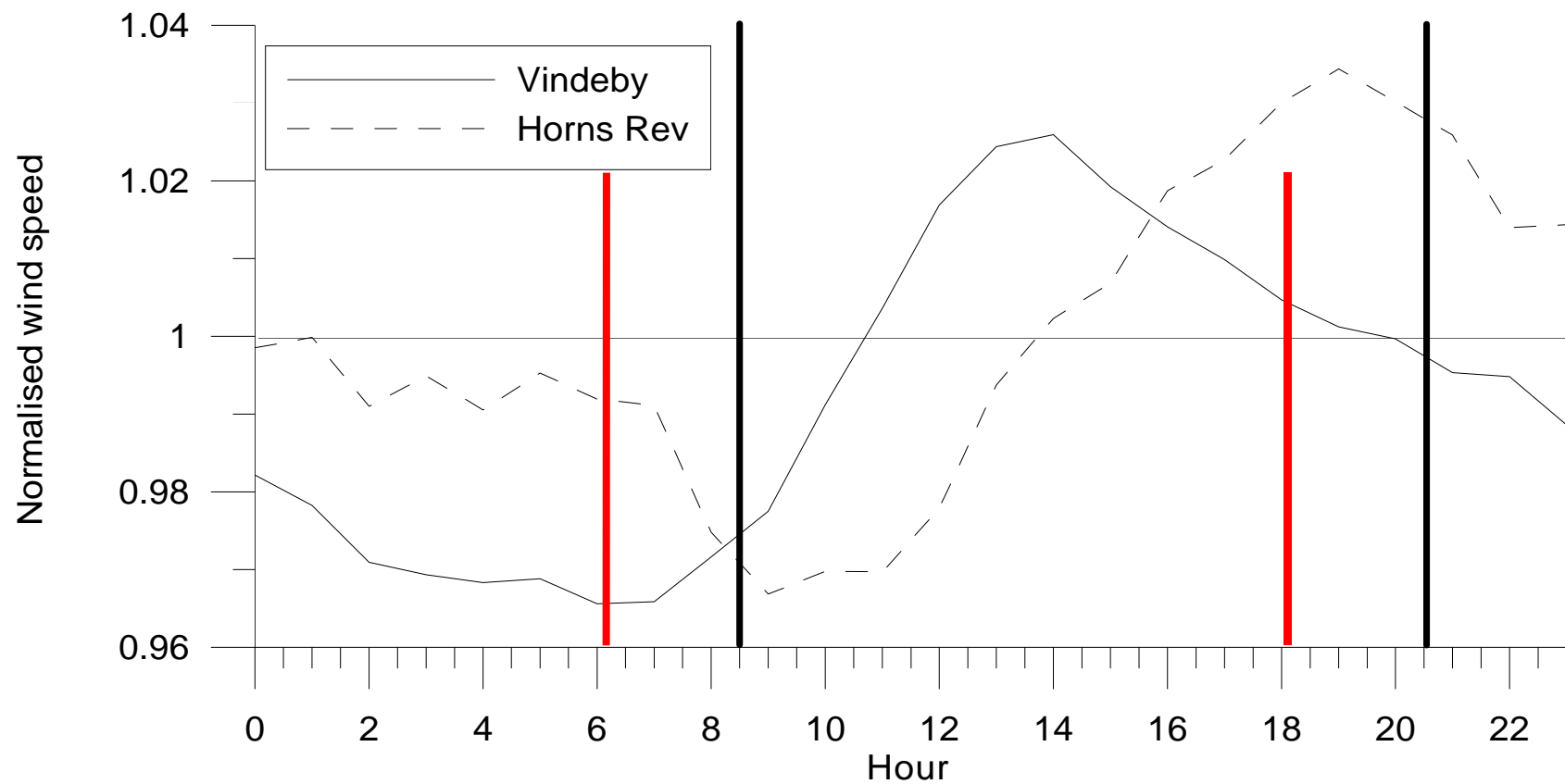


Diurnal wind speed variation

Vindeby in Baltic Sea

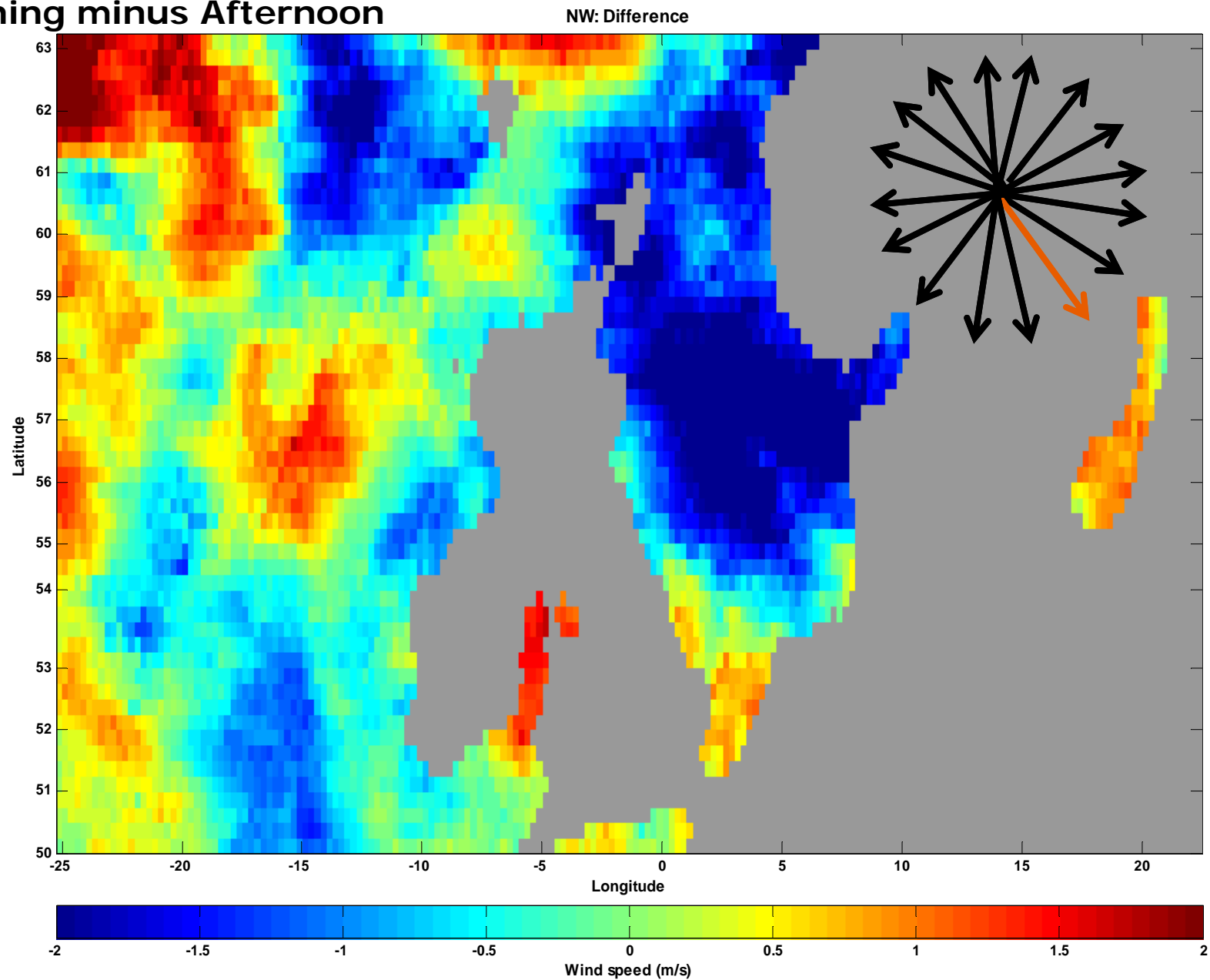
Horns Rev in the North Sea

Sampling times: red vertical QuikSCAT and black Envisat ASAR



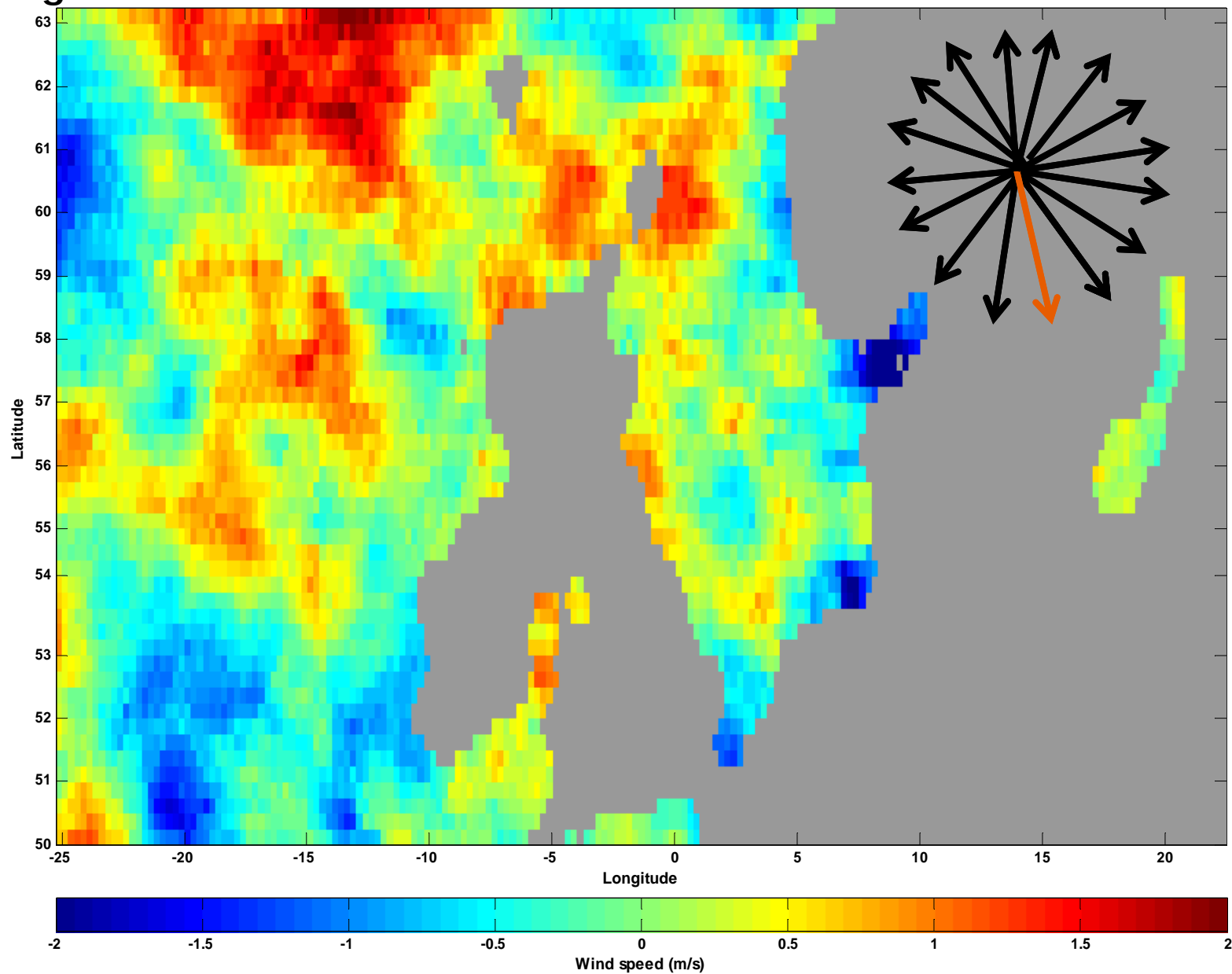
(Barthelmie & Pryor 2003: J. Applied Meteorology 42, 83-94)

Average Wind Speed: Difference (based on wind direction at Horns Rev) - 16 Directions Morning minus Afternoon



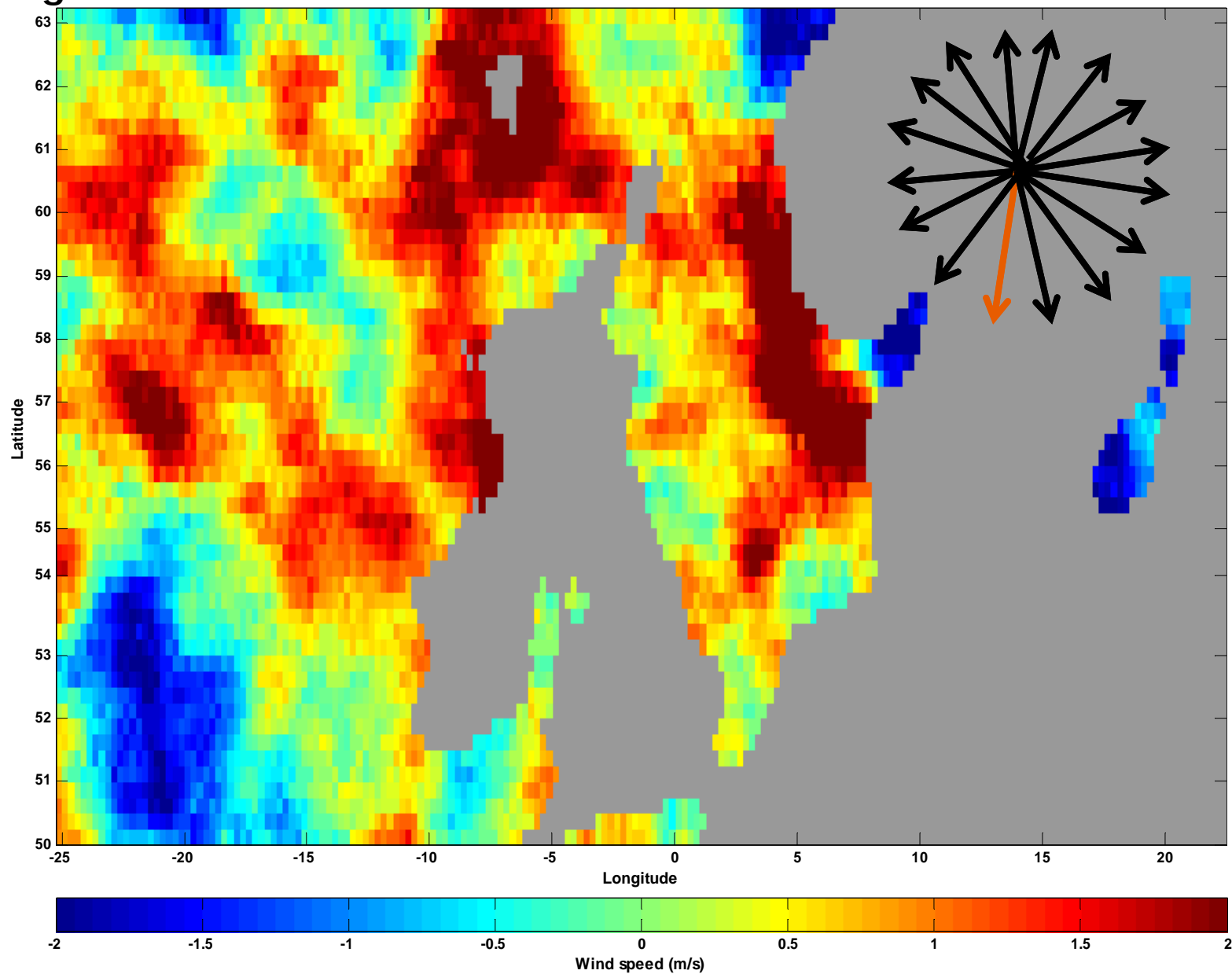
Morning minus Afternoon

NNW: Difference



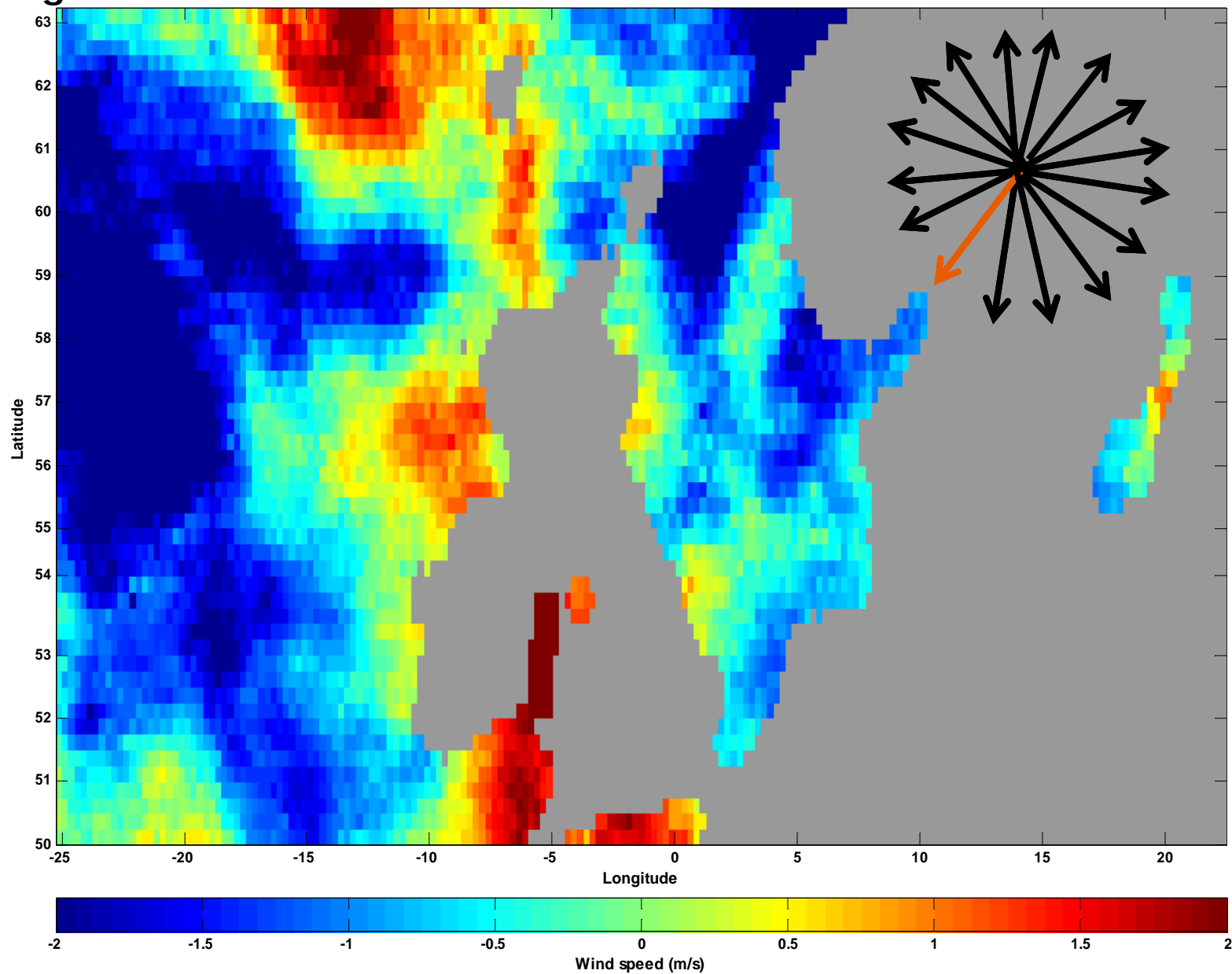
Morning minus Afternoon

NNE: Difference



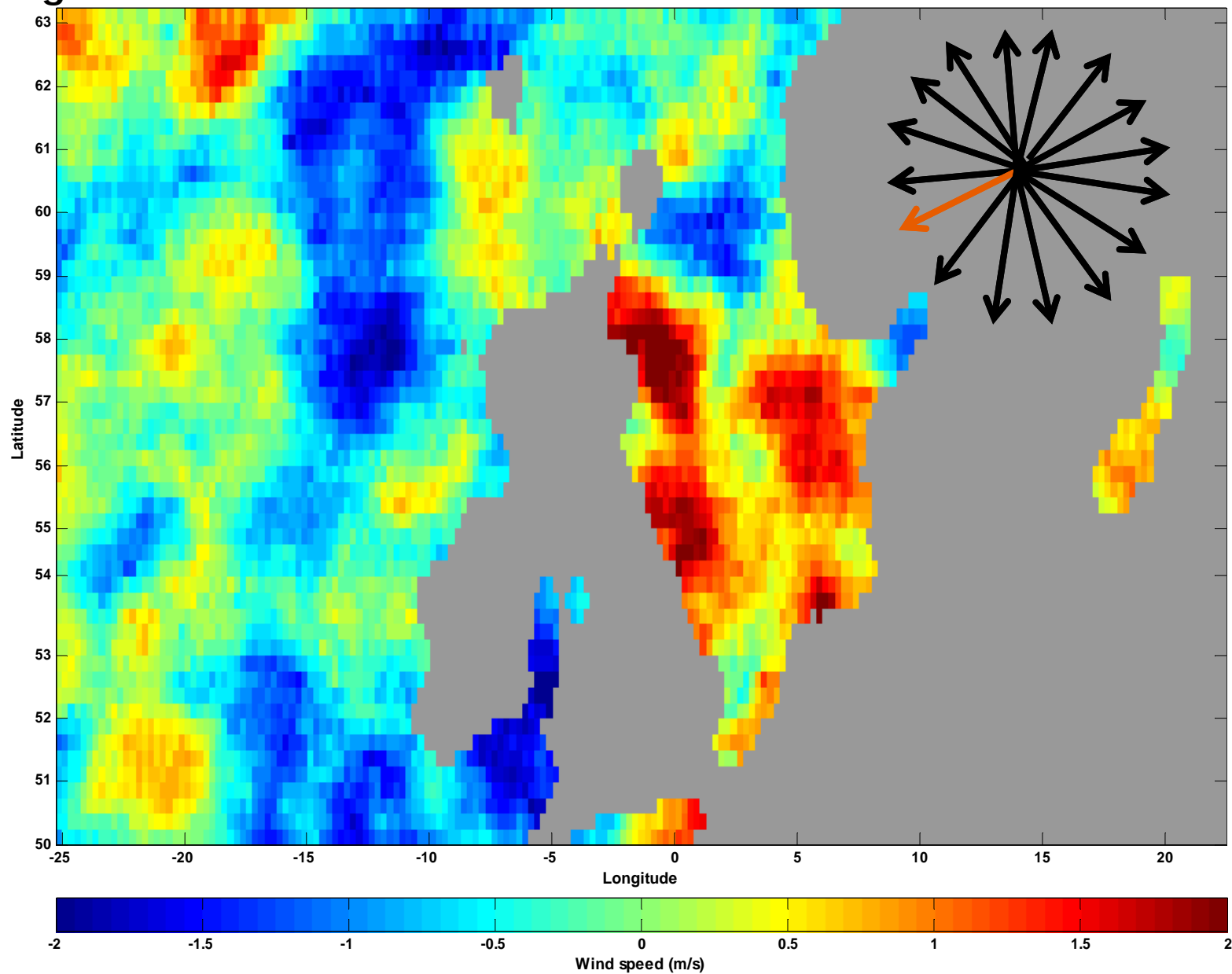
Morning minus Afternoon

NE: Difference



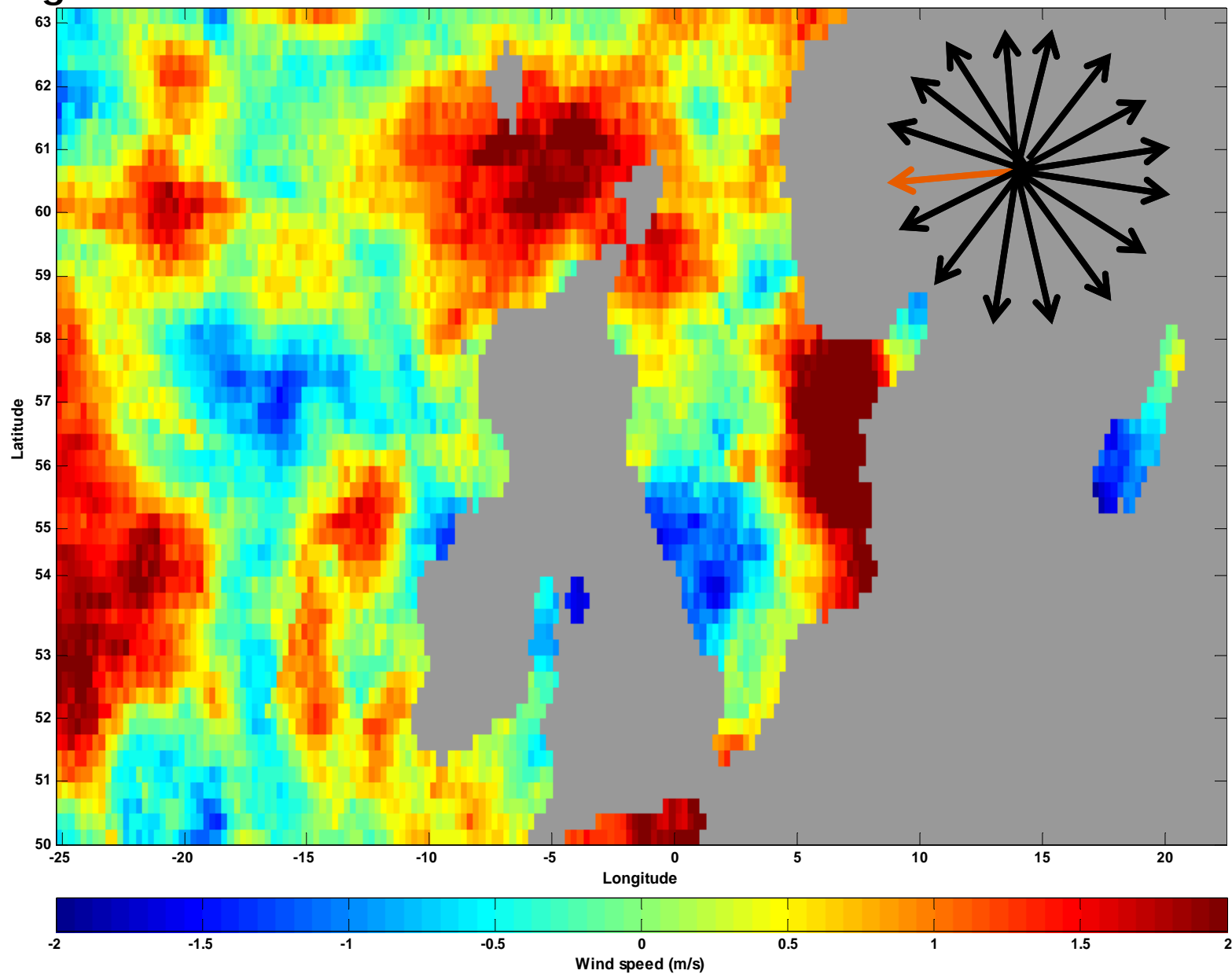
Morning minus Afternoon

EN: Difference



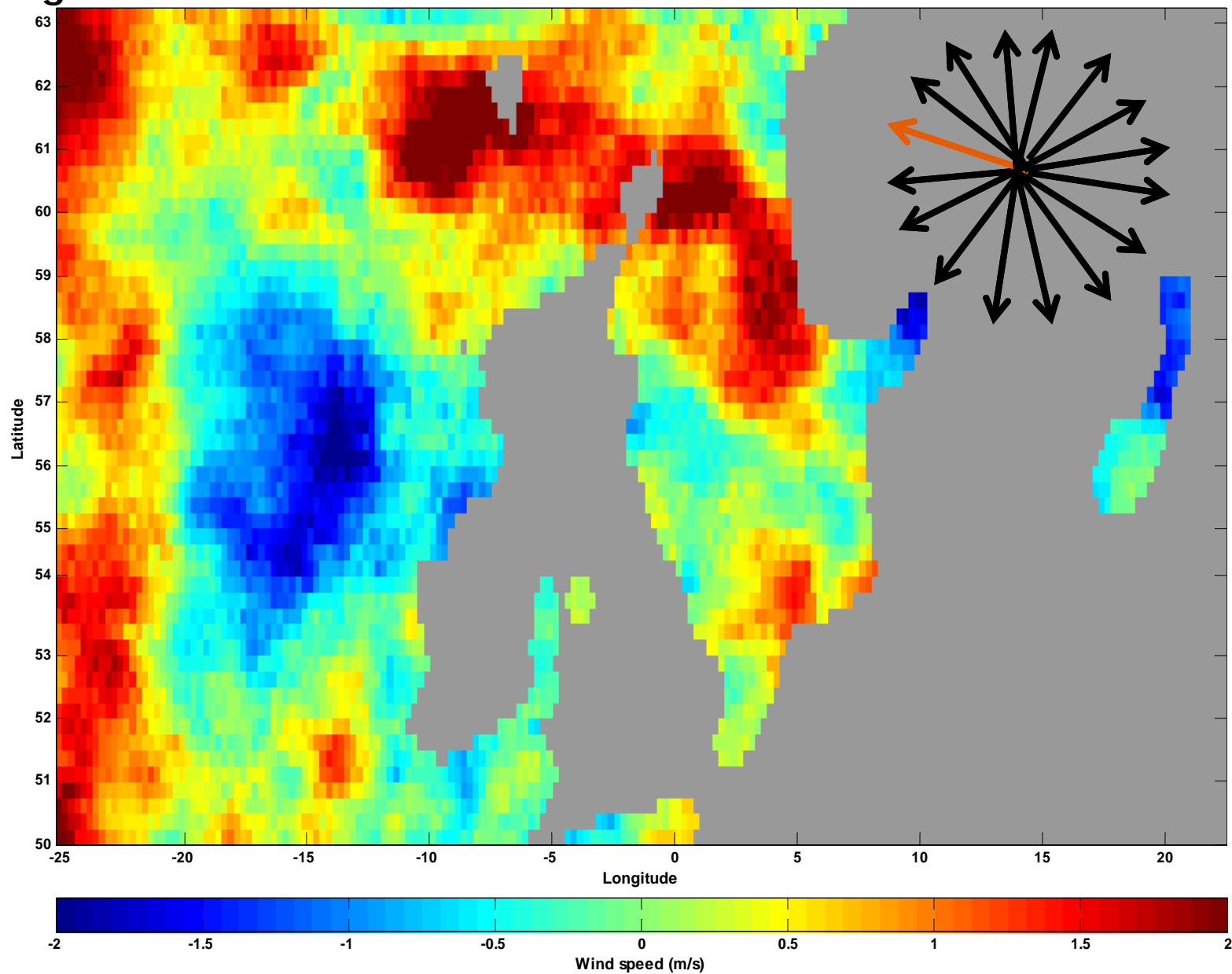
Morning minus Afternoon

ENE: Difference



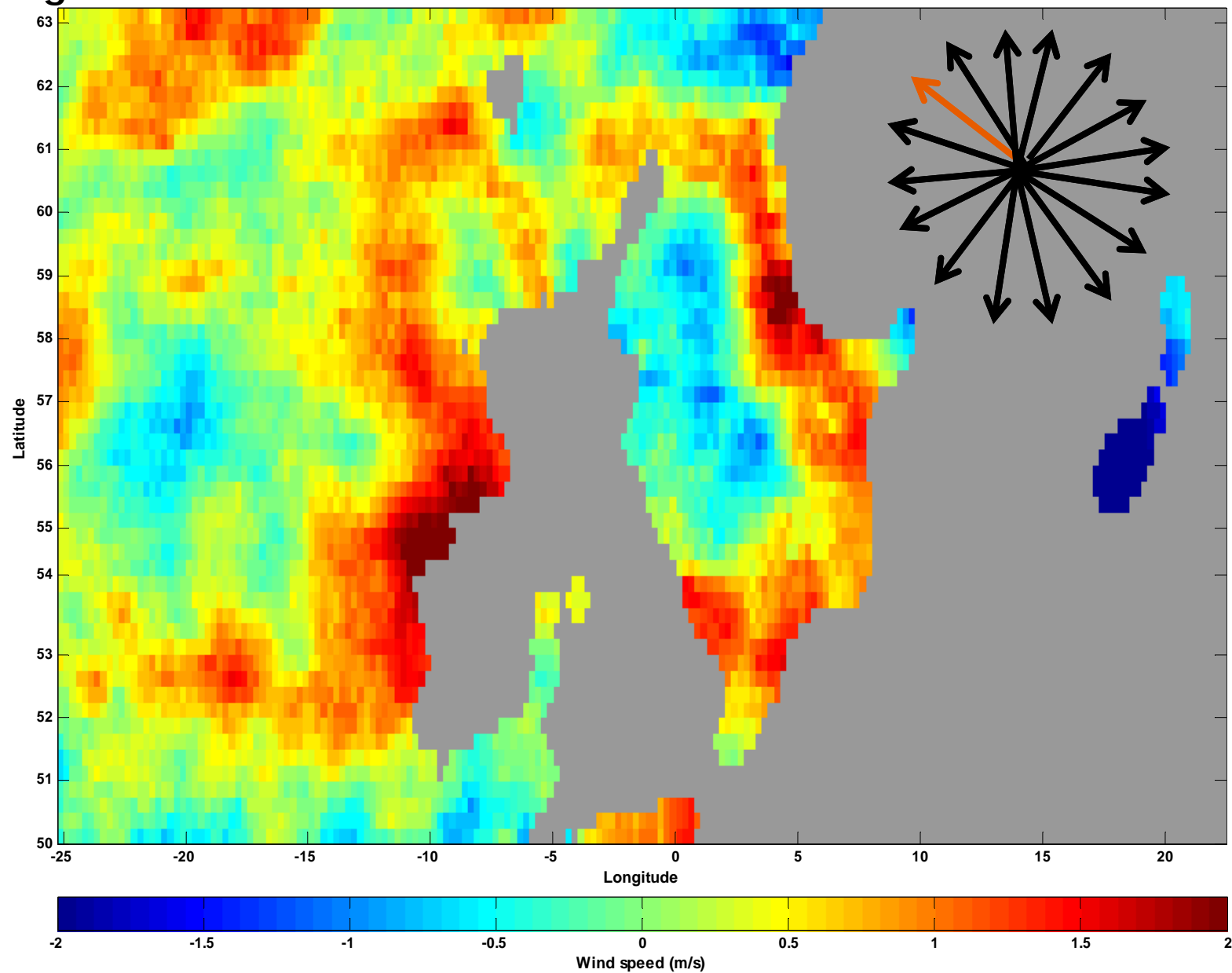
Morning minus Afternoon

ESE: Difference



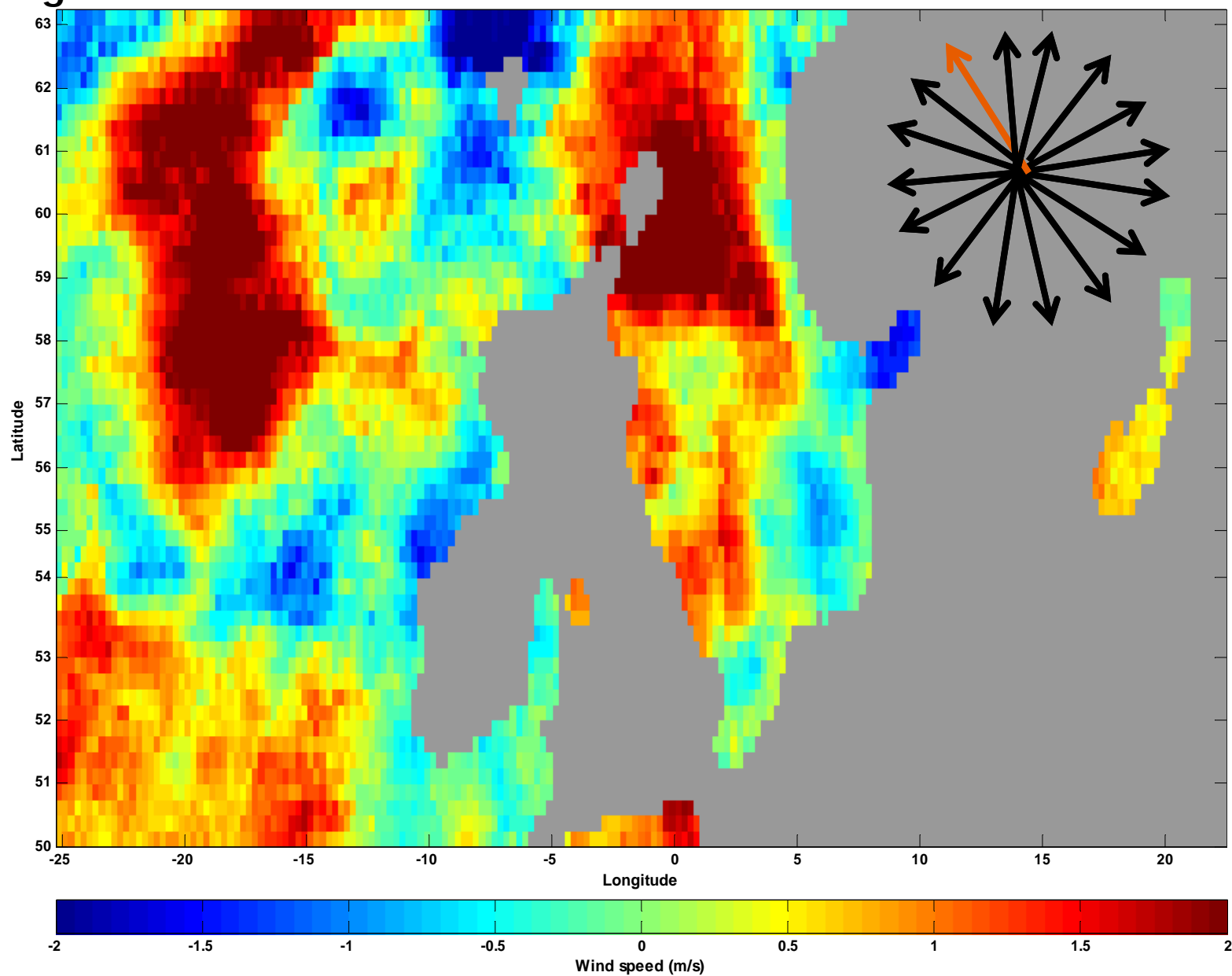
Morning minus Afternoon

ES: Difference



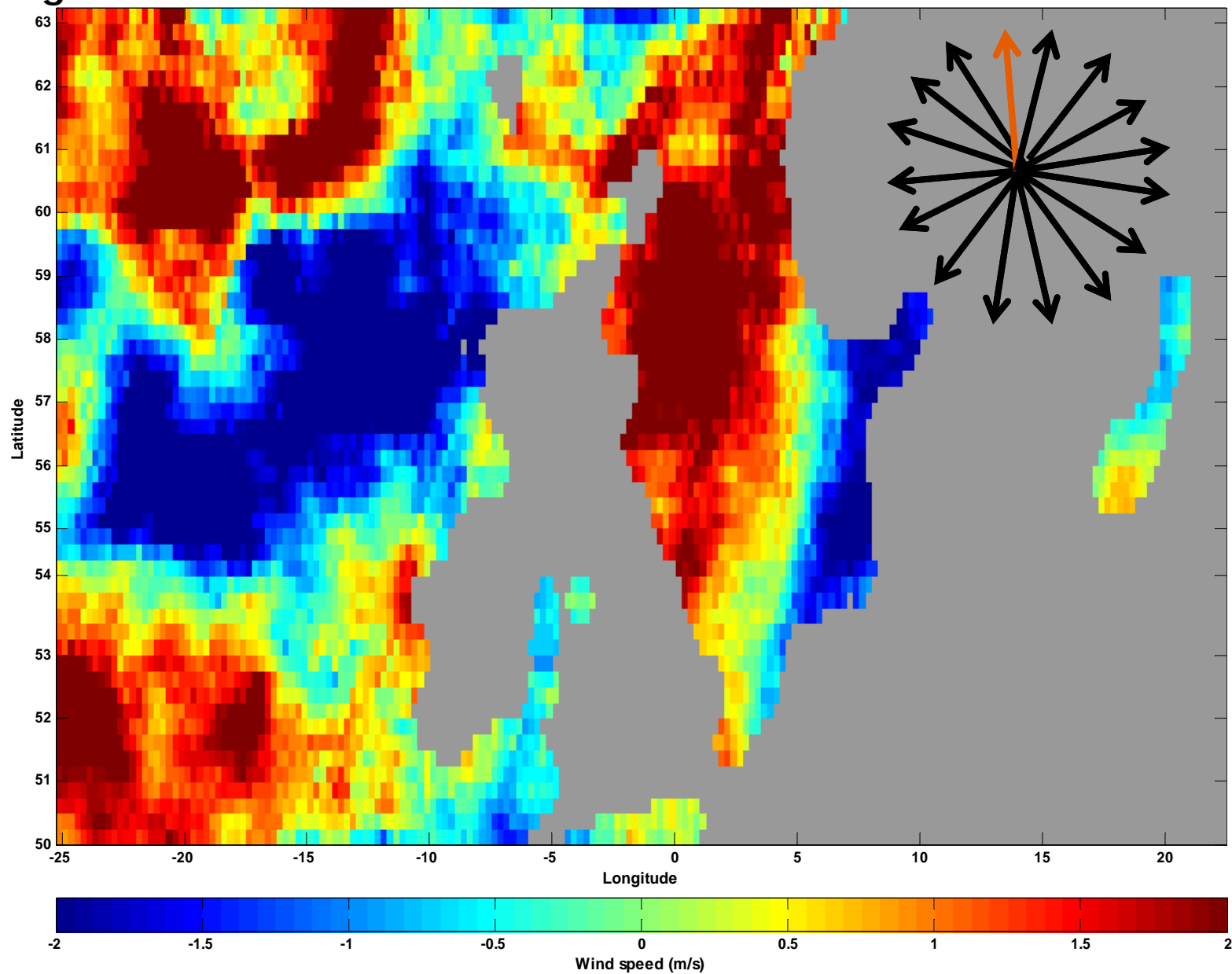
Morning minus Afternoon

SE: Difference



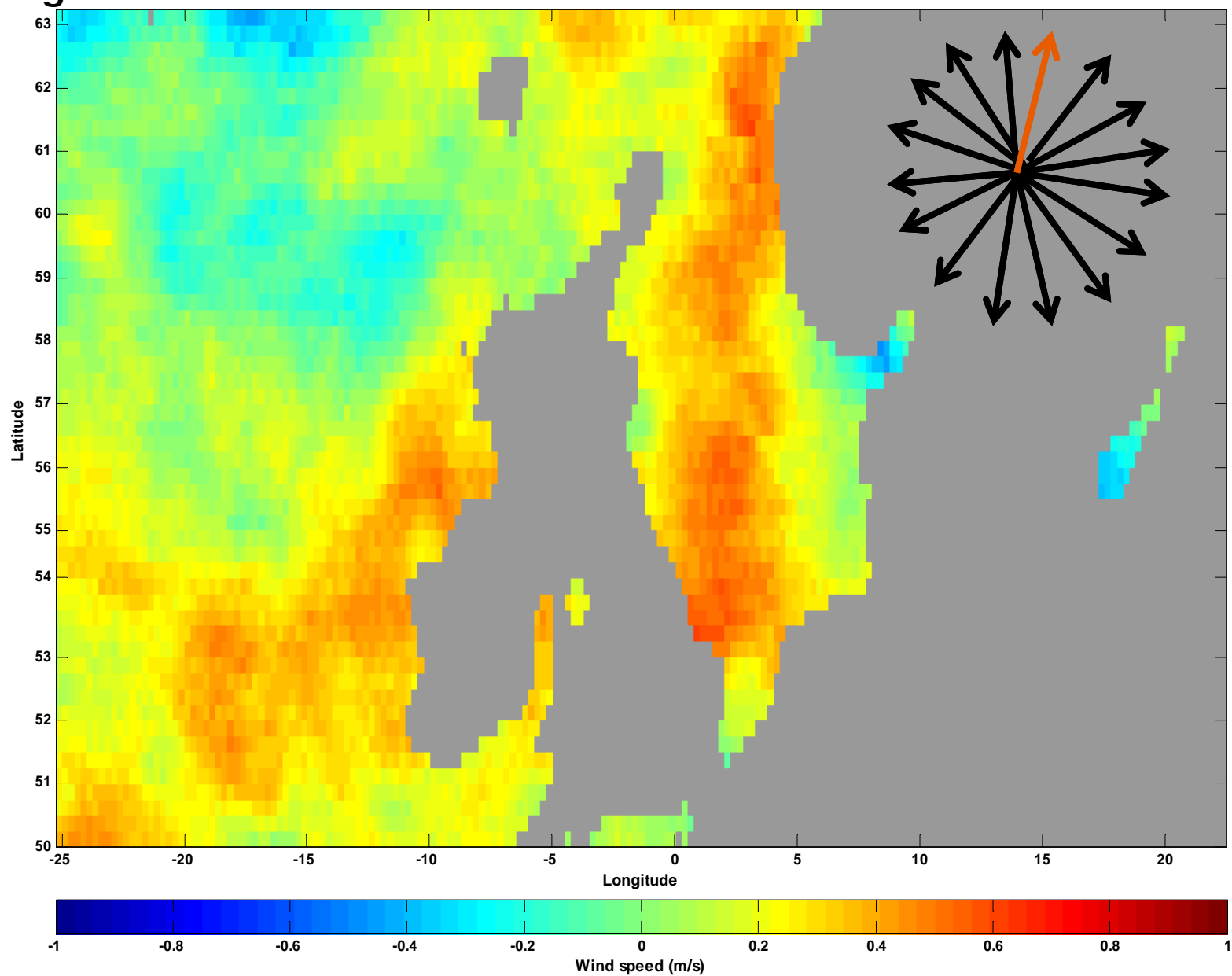
Morning minus Afternoon

SSE: Difference



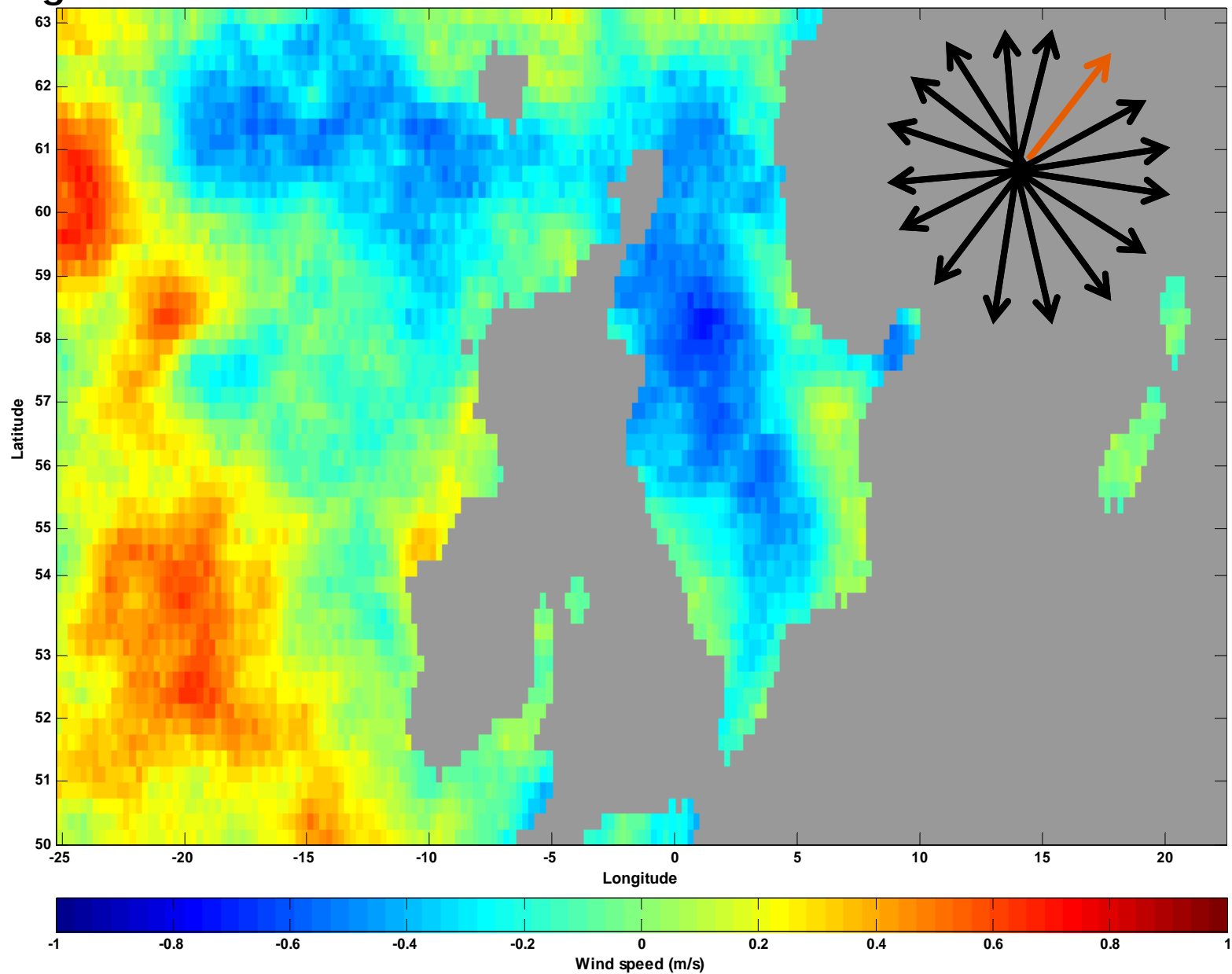
Morning minus Afternoon

SSW: Difference



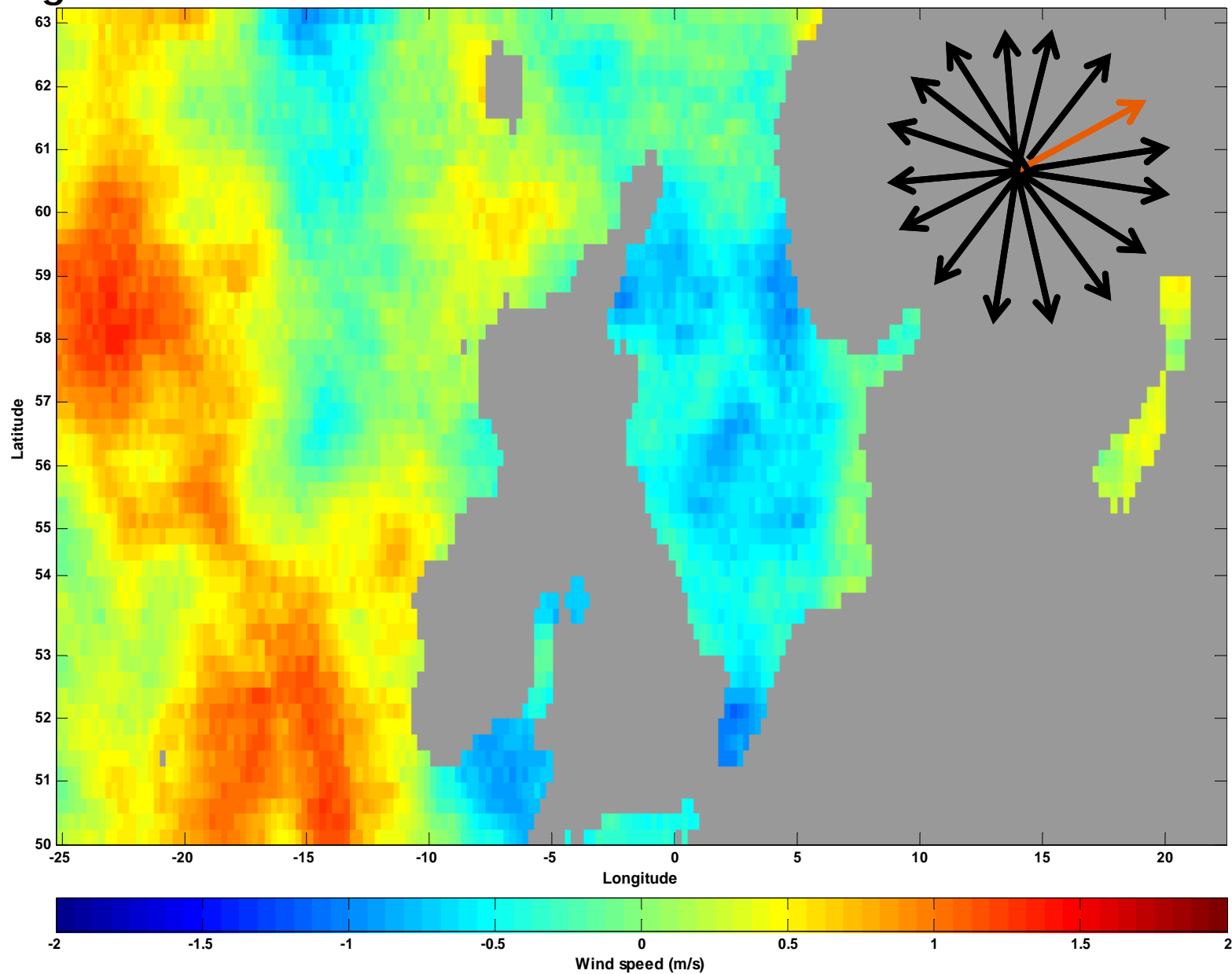
Morning minus Afternoon

SW: Difference



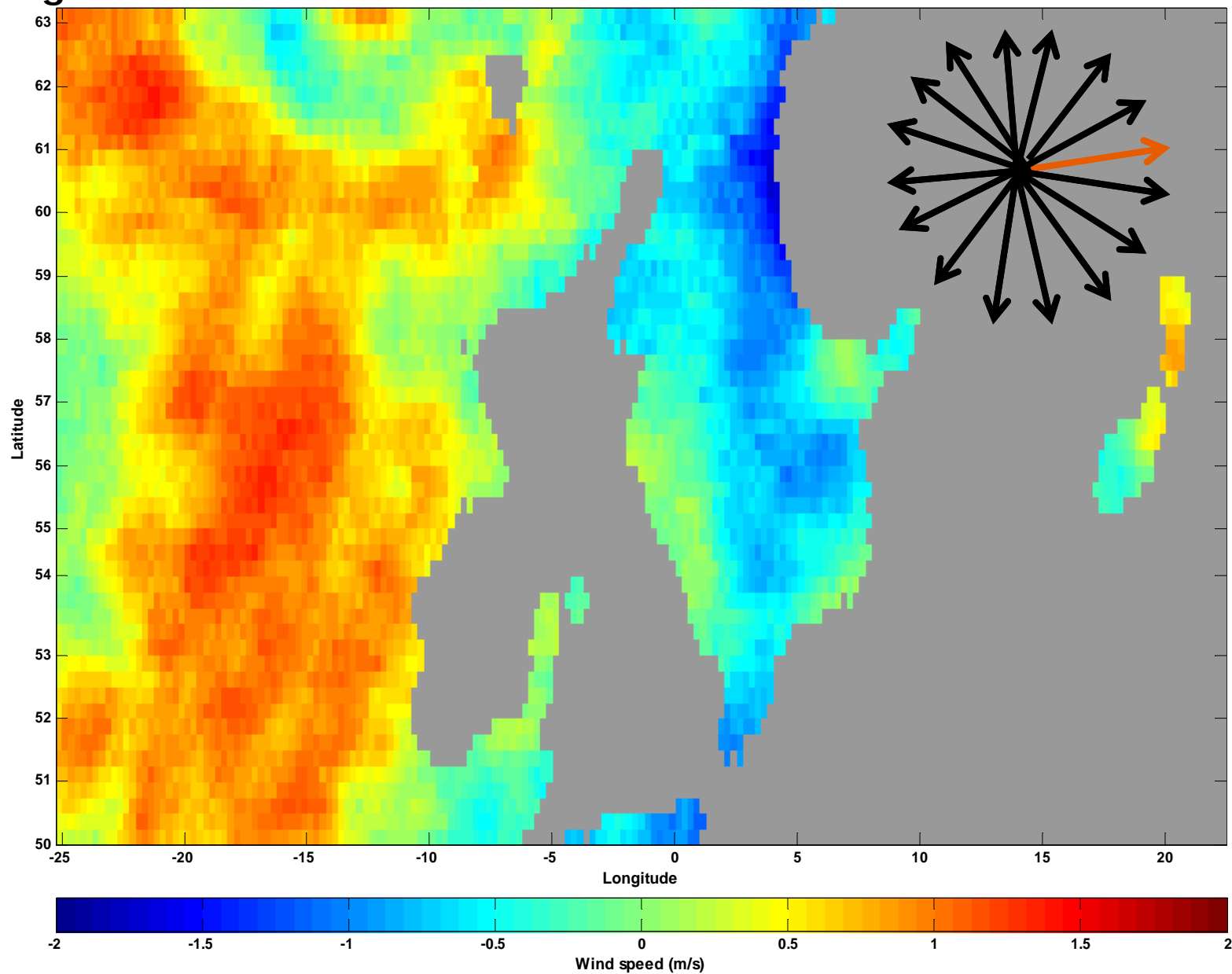
Morning minus Afternoon

WS: Difference



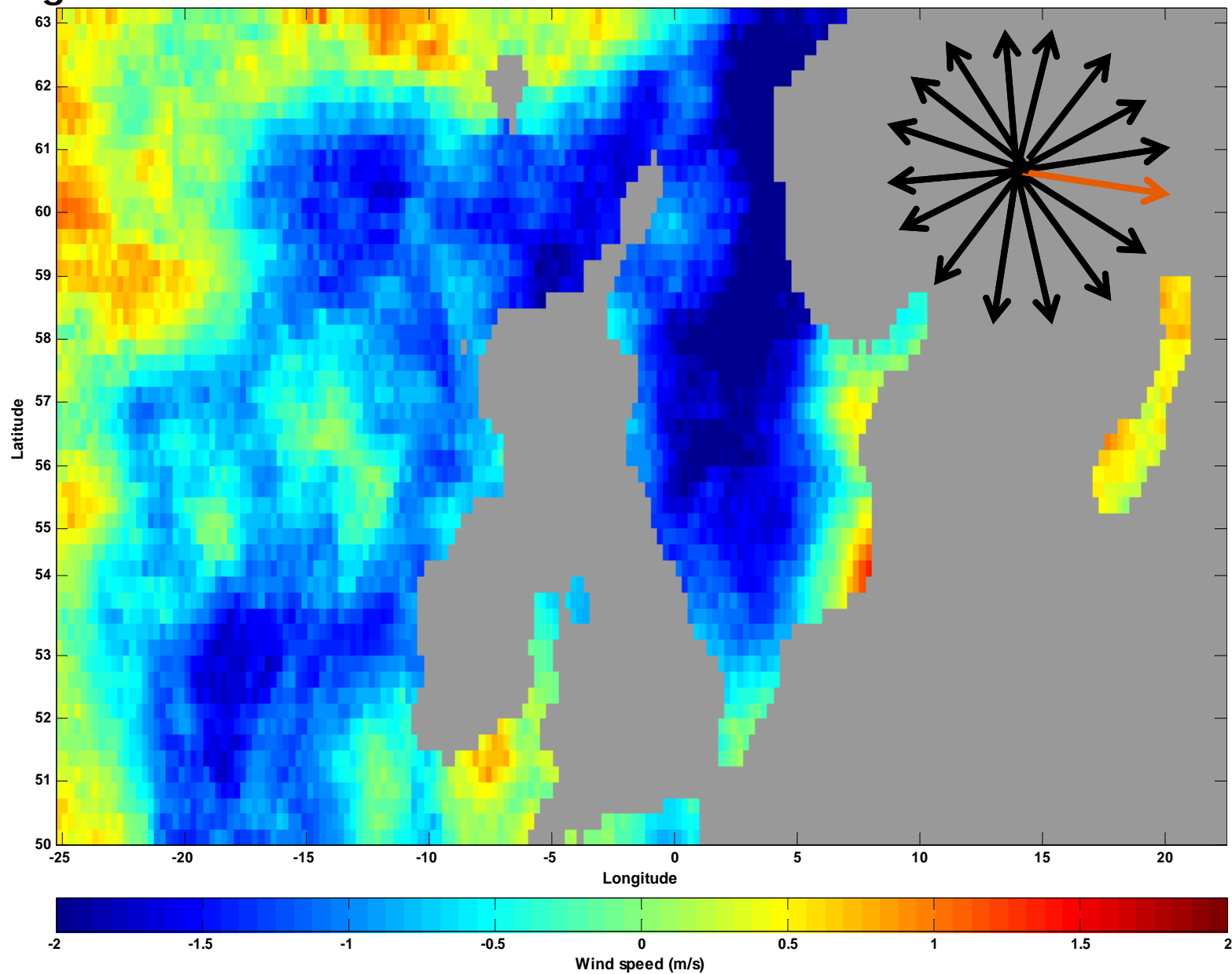
Morning minus Afternoon

WSW: Difference



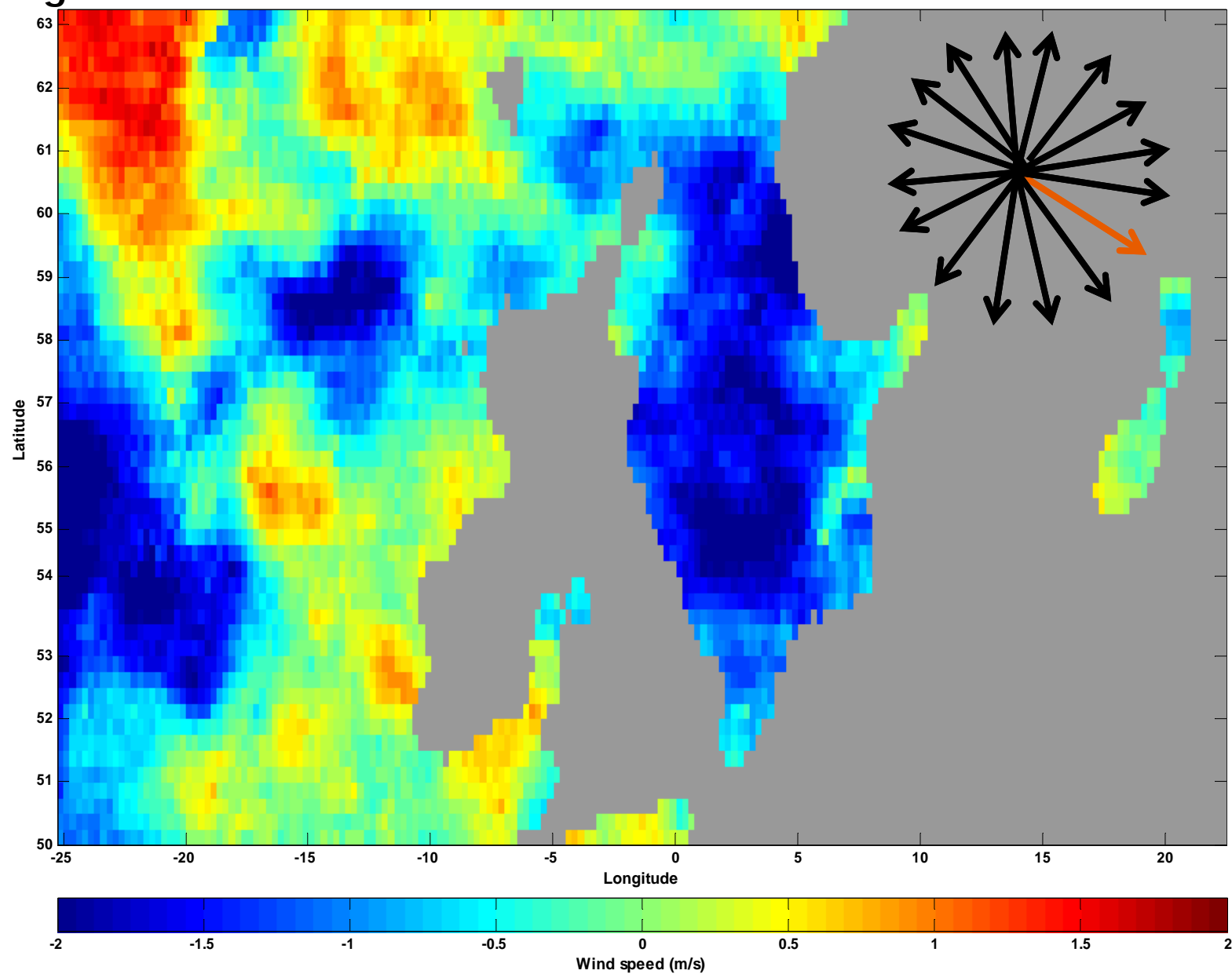
Morning minus Afternoon

WNW: Difference

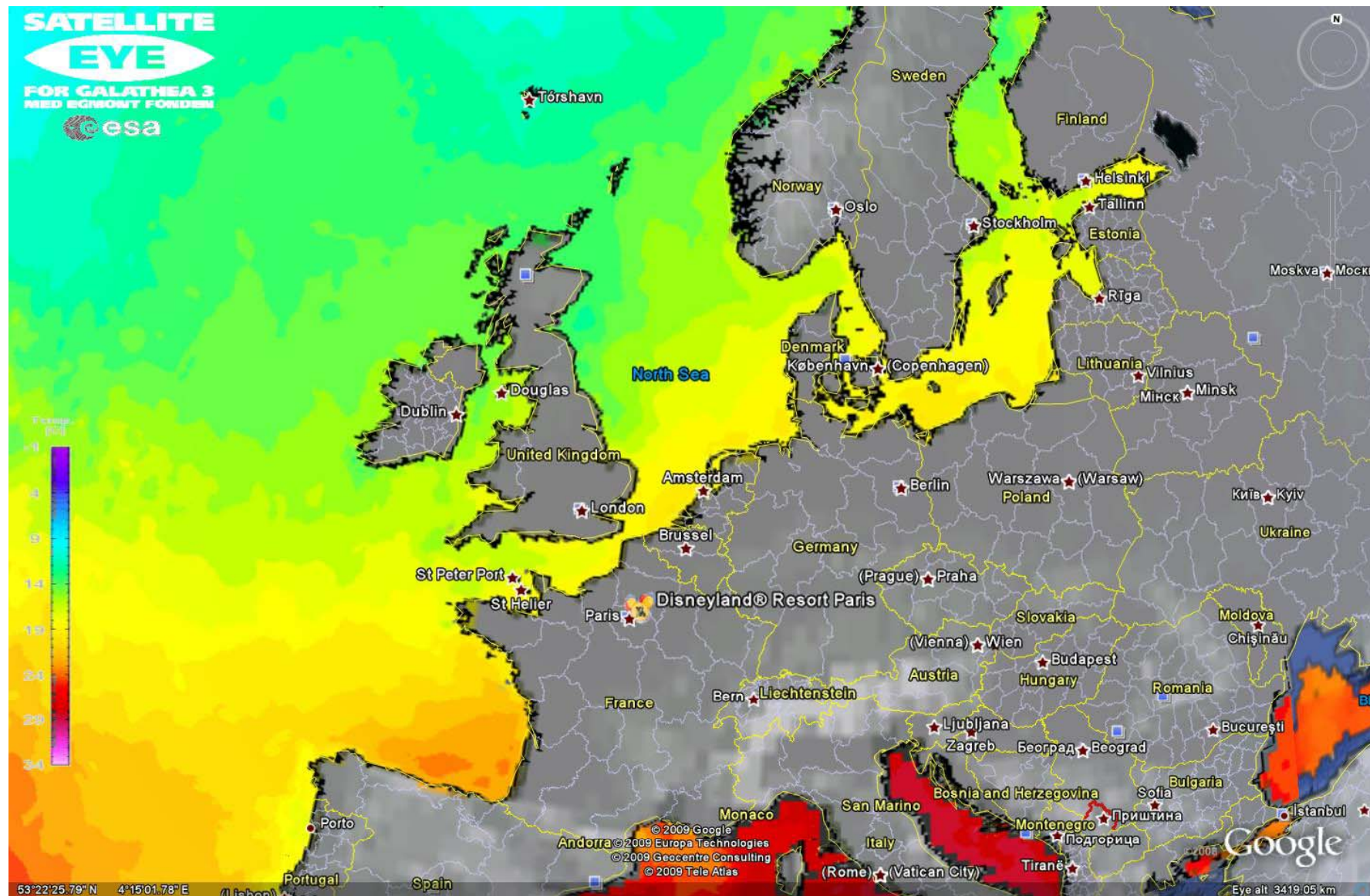


Morning minus Afternoon

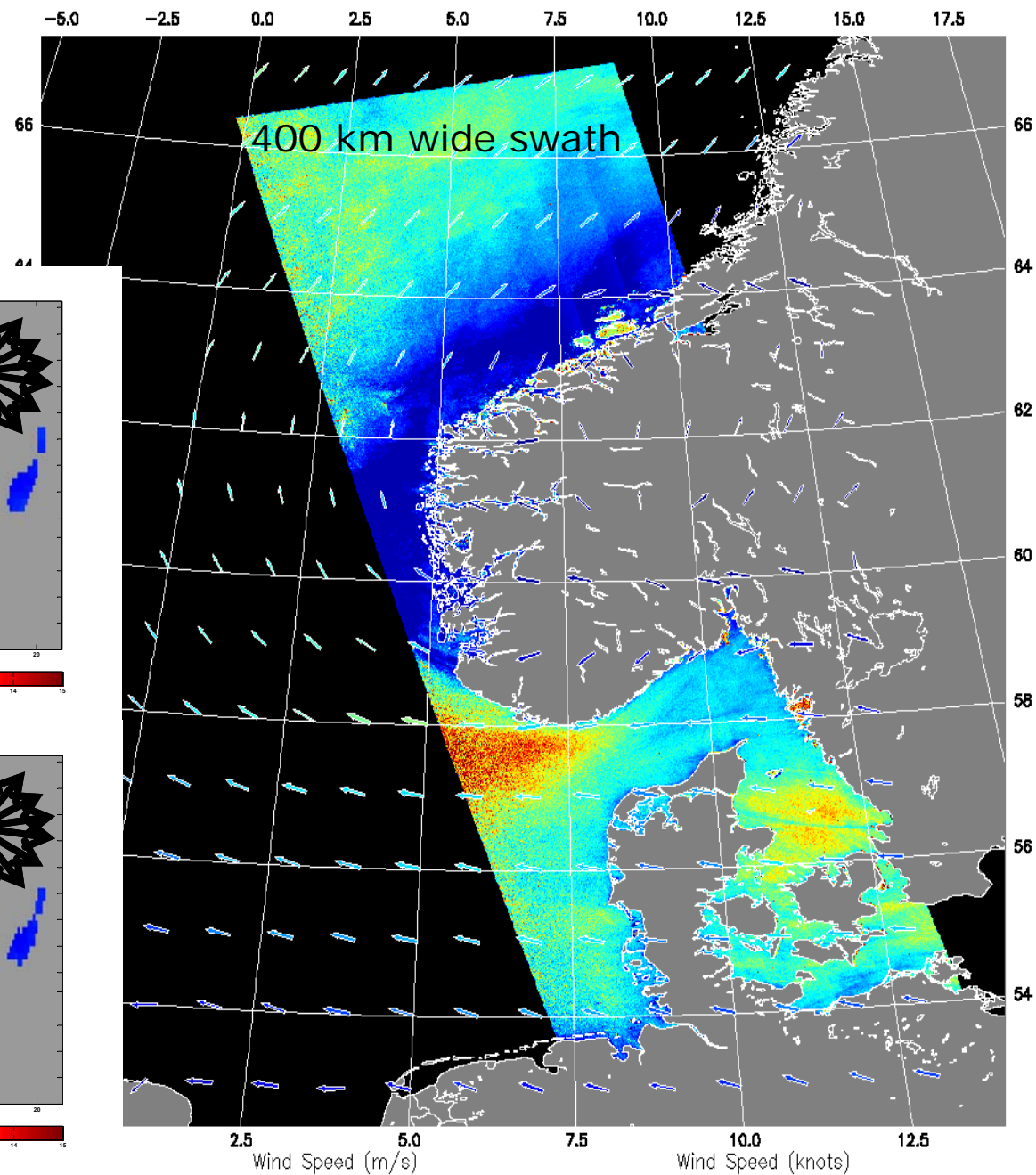
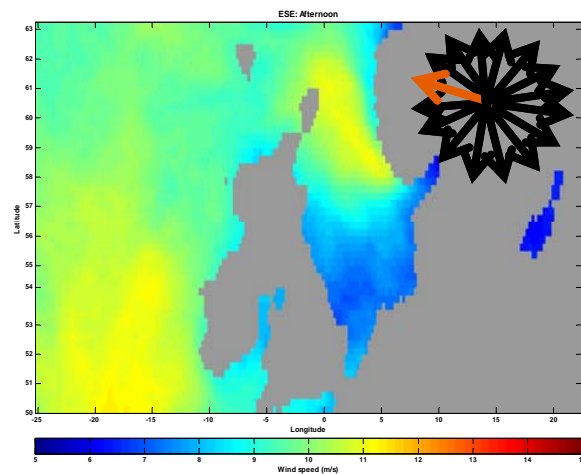
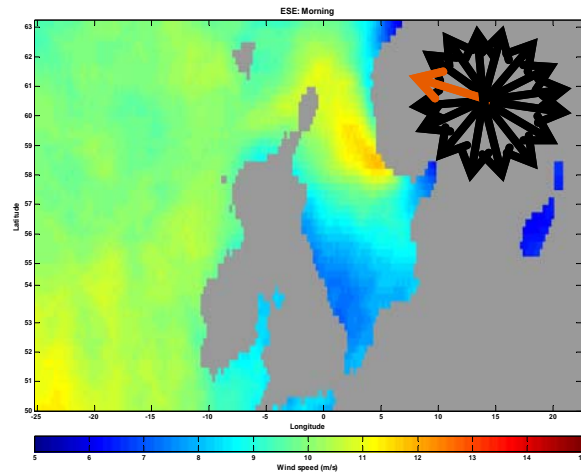
WN: Difference



Sea surface temperature: 30 August 2009

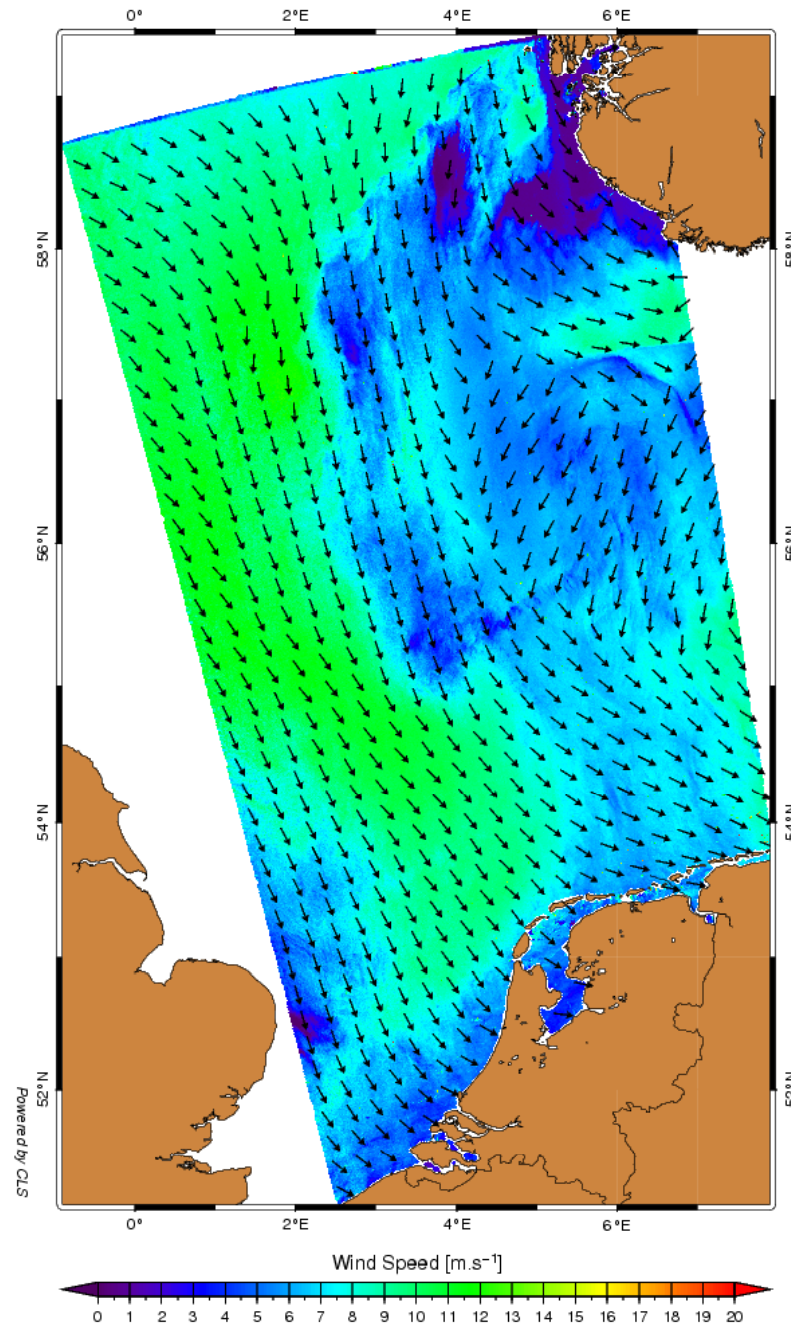
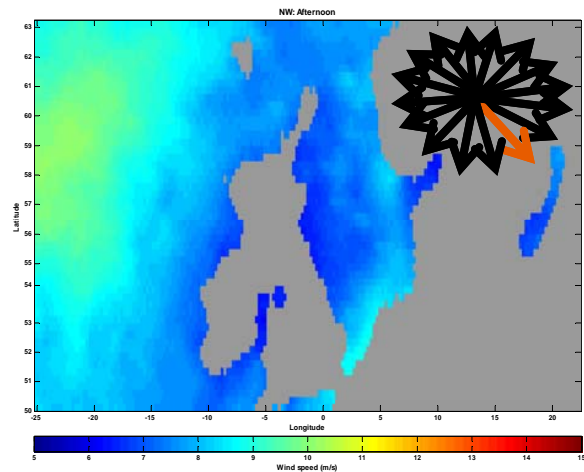
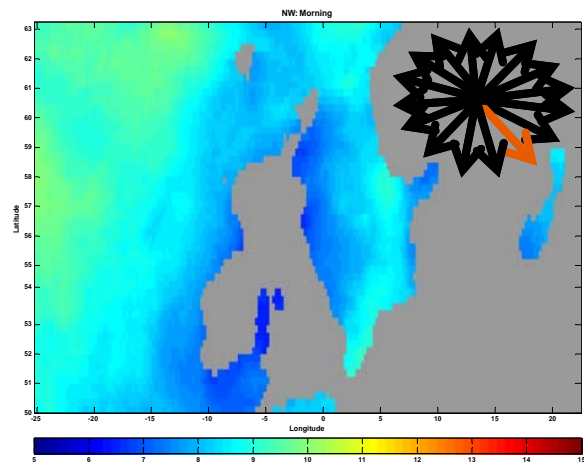


Wind map from Envisat



Wind map from Envisat

Download at



Future

1. Detailed analysis of coastal, diurnal wind variations (QuikSCAT and Envisat)
2. Detailed analysis of offshore wind and sea surface temperature
3. Comparison to observations (EU-Norsewind)
4. Comparison to mesoscale model results (EU-Norsewind)

Further references:

Hasager et al. 2009 **Satellite winds in EU-Norsewind**, EWEC 2009 Scientific proceedings (ISBN:) , pages: 144-147.

www.Norsewind.eu